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## THE INVERTED GAS-MANTLE BURNER.

In the report printed elsewhere in this issue of the very successful meeting last week of the Illuminating Engineering Society, there will be found an abstract of a paper on the inverted gas-mantle burner for interior service, which recently has been attracting much attention abroad and in this country. If we are to give credence to the gas engineer who presented the paper, the possibilities of this new type of gas burner have been grossly exaggerated, and electric lighting has nothing to fear from its competition. In printing, however, this destructive criticism—so surprising from a gas engineer—a word of caution to the electric lighting fraternity seems called for. The gas-mantle burner is only in the first stages of development, the patents on most of the forms now in the market having been issued within the past few years, and many inventors are hard at work on its perfection. In Europe this new type has been taken seriously and appears to have already established some foothold. In this country the advertising pages of one of our gas contemporaries are overflowing with enthusiastic announcements of various types of "The Light of the Future," and in New York City brilliant displays of the inverted burner can be seen in the show windows of some of its many exploiters. While the only specific advantage of the new over other gas burners with respect to competition with the incandescent electric lamp is that it admits of decorative bracket and ceiling pendant dispositions imitating those heretofore only associated with electric lighting, it is nevertheless well for central station men to keep an eye on its development. In the meantime, the thanks of central station managers are due to the author of the paper for the long catalogue he gives of the defects of a possible competitor, which information should prove useful where the inverted gas mantle may seek for public favor as a rival to the incandescent electric lamp.

## DEFLECTION POTENTIOMETERS.

The potentiometer, which dates back to Poggendorff, is an invaluable piece of electrical laboratory apparatus for calibrating voltmeters and ammeters. It is distinctly a null-method instrument in its standard form. That is, it requires the use of a galvanometer, the deflection of which must be adjusted to zero in order to secure the balance on which the measurement depends. An article this week by Mr. H. B. Brooks, on page 564, describes a modification of the potentiometer as constructed at the Bureau of Standards, in which for certain purposes the null-method is partly replaced by a deflection method. That is, an approximate balance, or approach to zero, is first obtained in the ordinary way, and then the reading of the galvanometer, or its deflection, from the zero of correct balance, marks off the value that would otherwise have to be obtained from a careful resistance adjustment. This deflection type of potentiometer is thus in part a direct-reading instrument, and is somewhat swifter to work with than the ordinary balance potentiometer. Special arrangements and precautions have to be taken, however, in the deflection potentiometer, in order to maintain the uniformity of the galvanometer scale reading values at all parts of the range afforded with the instrument. It would seem from the description, that for portable use in central station instrument service,

and for special types of laboratory work, the instrument might be very convenient. The standard balance form is, we think, likely to remain in favor for precision laboratory work.

## Refrigerating Central Station Load.

Elsewhere in this issue are given figures on the actual cost of artificial refrigeration in a meat market at Beloit, Wis. As will be seen, the electrically-driven refrigerating machine taking power at the central station company's regular rates makes a showing far below ice both as to operating expenses and total cost, including fixed charges on the refrigerating plant. It goes without saying that this class of work furnishes about as desirable a kind of load as a central station could ask for, as it can be kept entirely off the peak. Some time ago we printed an account of the excellent economy attained with the electrical refrigeration system in Philadelphia, where it has been introduced upon a considerable scale. The figures for Beloit indicate that the smaller central stations can also make refrigeration a source of income, and this demonstration should not be passed unheeded by the enterprising manager.

## The Flaming Arc Lamp.

A paper presented last week before the Illuminating Engineering Society, an abstract of which is given elsewhere, brings out strongly the enormous light efficiency of the flaming or luminous arc lamp. Tests, of which data are given in the abstract, show that on the basis of spherical or total flux, a candlepower is produced on .353 watt, as compared with 1.78 watts for the enclosed arc light, 1.9 watts for the tantalum filament, and 3.9 watts for the ordinary (3.1 watts nominal) carbon filament. Other advantages of the lamp noted are the excellent quality of the light, both in color and steadiness, and its superior distribution. Aside from the present price of the lamp and electrodes, the main disadvantage is attendance due to the short life of carbons as compared with the enclosed arc and necessity for removing vapor deposits. Doubtless competition will take care of lamp cost, and we are informed that the composite electrodes used with the lamp are already manufactured in this country at a great reduction from the recent price of imported electrodes.

## The Life of Frosted Lamps.

Elsewhere in this issue are given the results of some interesting tests made to determine the effect on the life of a lamp of the two common methods of securing diffusion of the light from the bare filament—namely, by frosting the lamp bulb and by enclosing it in a diffusing globe. This question is one which becomes of greater importance as more attention is given to the proper diffusing and softening of the light from incandescent lamps. That such diffusing is desirable where lights are placed in the ordinary line of vision is unquestionable. It is also desirable, although not so necessary, where close work, such as reading, writing and drawing, is done under the light of an incandescent lamp, for the reason that the light coming through a diffusing bulb or globe is more comfortable to work by than if from a clear bulb lamp, since it approaches more nearly the character of daylight, in that the glare of regular reflection from the paper and the shadows are less pronounced. Cases without number come up in practice where the engineer must decide whether to place lamps in diffusing globes or use simply a frosted bulb lamp, and the question of how much the frosting of a lamp bulb reduces its life or how much enclosing it in a globe reduces its life has received almost no consideration.

The tests cited by Messrs. Cravath and Lansingh in the article referred to show that the reduction of life of an ordinary 3.1-watt incandescent lamp by frosting is about 52 per cent. The loss by enclosing it in a globe is only about 5.5 per cent. It has been known in a general way for a long time that frosting of lamp bulbs materially reduces the life, but reliable tests seem heretofore to have been wanting. These results will probably cause the selection of enclosing globes rather than frosted bulbs for purposes of securing diffusion in the majority of cases where there are not good reasons why they cannot be used. If the enclosing globe is of frosted or sand-blasted glass with the smooth surface outside, and the neck of the globe is closed with an asbestos or mica cover as the authors recommend, the combination is much easier to keep clean than the frosted bulb. On the other hand, if the frosted bulb is in a location where it is burning a large number of hours per day it will probably burn out and be renewed before any great accumulation of dirt has been rubbed into its frosted surface by repeated cleanings. As far as the user of the light is concerned, even if he furnishes his own lamp renewals the extra cost of lamp renewals either with frosted bulbs or enclosing globes is so small as to be not worth considering in comparison with the advantages gained in the way of improved quality of illumination and artistic effect. There are many places where enclosing globes cannot be used but where diffusing glass is nevertheless desirable, and for such the frosted bulb still has the field to itself.

Up to date no very satisfactory combination of enclosing globe and reflector has been devised, although the results of these tests may set illuminating engineers to thinking along these lines. There would always be the inherent difficulty about any such arrangement that an enclosing globe must have a 3¼-in. holder and be of a size which interferes materially with efficient reflectors fitting closely around the lamp. Another interesting aspect of the situation is that presented to central station companies which furnish free renewals. Some companies furnish free renewals of frosted bulb lamps as well as of clear bulbs, while others make an extra charge for the frosted bulbs. The extra charge, if based on the difference in the initial cost of the lamp, will not begin to cover the actual expense involved in the use of the frosted bulb as against a clear bulb. However, since it is to the interest of central station companies to further any movement which is in the direction of improved and more artistic illuminating effects, the difference in the life of frosted and clear bulb lamps can well be left out of account.

## Measurement of Power in Three-Phase Systems.

The single-phase alternating-current system, when it first came into vogue, gave much trouble to electrical engineers in regard to the measurement of power delivered. The direct-current system, which was then familiar, permitted the power to be ascertained very readily. All that was necessary was to insert an ammeter in the circuit, and multiply the amperes by the main voltage of delivery. Direct-current recording watt-hour meters were also constructed and installed without great difficulty. All this was changed when the alternating-current system made its appearance. The power delivered was not proportional to the current strength. Only particular types of recording watt-hour meters would register correctly on alternating-current circuits. In time, however, these difficulties were overcome and forgotten. When the three-phase alternating-current system

came into use electrical engineers were again perplexed by the problem of measuring the power. The voltages per phase were out of step with the currents in the wires even on the best balanced and most regular three-phase system. When the system was unbalanced, the conditions were still worse. Finally, the engineers adopted the two-wattmeter method for ordinary purposes, and this correctly indicated the power delivered on any three-phase system, whether balanced or not.

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On page 563 this week Mr. E. R. Shepard describes a method of measuring the power in a balanced three-phase system, using two wattmeters, but only one voltage transformer. This method may be very convenient to fall back upon, when one of two regular switchboard voltmeter-transformers gets out of order. No change in the switchboard arrangement is required beyond shifting the secondary wires of the injured transformer to the uninjured one, which thereby has to supply a doubled secondary current. Even if the plan is liable to error, by reason of unbalancing in the system, it is better to have a pair of recording watt-hour meters which will give the energy delivered within a few per cent, than to have the record entirely lost by reason of a break down in one of the wattmeter transformers. The plan is easily remembered, and is a useful device to keep in the central station engineer's note-book.

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## SUBSTATION CONSTRUCTION.

The huge Toronto sub-station described in this issue is particularly worth consideration as being both the largest yet erected in point of capacity, and the most complete example of cellular construction ever attempted. Add to this example the long transmission at the maximum voltage in use and the importance of the plant commands instant attention. The most interesting feature to the engineer is the extremely intricate system of subdivision of units employed throughout. There have come to be two distinct lines of design in high-voltage work. The fundamental aim of the one is simplicity, of the other safeguards. The former regards, in dealing with extreme voltage, every switch, separate unit and concealing barrier as a more or less necessary evil and pins its faith in the best possible initial construction of apparatus and its installation where it can be watched; the latter regards each step of subdivision and each inerpolated device as a safeguard for possible trouble, in spite of any attainable excellence of construction. The Toronto station is a very perfect example of the pessimistic theory of design which provides for the $n^{th}$ possible trouble an $(n \div 1)^{th}$ safety precaution. To begin with, there are to be four transmission circuits of the modest capacity of 7,500 kw each. Each of these is treated as an independent unit with its own full bank of three transformers, each of 2,400 kw output, and in addition there is provision for working in multiple to any desired extent. In each group every individual line, transformer and oil switch is in an individual cell, and to an extent never before realized, every part of the apparatus is isolated from every other part.

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Of course, for this equipment the principle of remote control must be carried to the last refinement, and so in fact it is. It is difficult to see how with all these precautions the failure of any single piece of apparatus can by physical contact involve any other piece; and yet since all are in electrical connection, no amount of isolation can prevent the spread of trouble under certain conditions. In spite of the good points of cellular construction, we feel it necessary to press this warning. For instance, in that tremendous case of destructive surging a couple of years since in one of our metropolitan power houses, no amount of isolation of individual apparatus would have prevented a shut down. The burning out of a single unit from an electrical cause costs just as much whether it occurs in an open power house or in a locked masonry cell. In the last analysis, cellular construction is mainly a precaution against fire as such, rather than against electrical failures which, with standard apparatus, are equally likely or unlikely to happen irrespective of the location of the units. One of the most striking features of the Toronto plant is the remarkably good protection given to the high-tension wiring, which is far too often left to the last moment and inadequately provided for. High-voltage wires should be located either so that they can be easily inspected or so that they will not need inspection; and in a cellular station the latter arrangement is evidently the only one possible. We do not think the staff of the Toronto station will have to worry much about their 60,000-volt leads. In such a plant the lightning arresters and the cable connections are really the most vulnerable points. In the operation of the former we shall be much interested, since the lines are very long, and, from the high tower construction, somewhat exposed.

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A transmission of 75 miles at 60,000 volts in a rather unfavorable climate is a daring undertaking even in the present state of high-voltage transmission, and its performance will be watched with great attention. Already engineers are getting ready to consider 75,000 volts and more, and if this fine Canadian line at 60,000 volts gives first-class service, the next step will be taken with more confidence in the results. The line is uniformly the weakest point when it comes to such voltages, since there is probably the lowest factor of safety in the insulation, and the greatest exposure to danger, both electrical and mechanical. If the present limit of 60,000 volts is to be raised, it will be by better line equipment, for the apparatus can be made safe enough for much greater pressures. We have no doubt, for instance, that the high-voltage switches of the Toronto plant would serve admirably at 75,000 volts, and transformers can surely be made reliable at that pressure, if line troubles can be kept away from them. Perhaps with the immunity from internal disturbances which should be secured in the Toronto plant, that system may readily be the scene of successful work at even higher pressure. The troubles to be feared are those from the outside. As regards the principles of design followed in this instance, there is no general consensus of opinion among engineers. There is a point at which any further increase of plant complication and multiplication of safety devices tends to defeat its own ends, since the complexity may entail more ultimate care than would be required by a simpler construction. A plant like the Toronto one is not at all an easy one to handle in a real emergency, since the very isolation of the parts renders a quick grasping of the situation and prompt action almost impossible. We cannot imagine a conflagration in such a station, but we can easily imagine a breakdown as complete as in the case of an open station, and perhaps less easy to reach and remedy. The extent of precaution really desirable is, as we said at the start, still a moot point among those most competent to judge. Carried to the limit as it is in this case, the extra cost entailed is a very considerable item in the total cost of transmission. We would much like to know the actual complete cost of the Toronto station finished and ready to operate. That it is large goes without saying, but it would be very interesting to figure the cost of the insurance measures that have here been carried out with so exceptional thoroughness. It certainly is a masterly embodiment of the extreme point of view which it represents.

## Large Gifts to Institute Building Fund.

The chairman of the Land and Building Fund of the American Institute of Electrical Engineers announces this week some very large and important contributions to this fund, the object of which is to raise $200,000 for the land on which the United Engineering Building, given by Mr. Carnegie, is now being executed. The total cost of the land is $540,000, and the obligation is divided between the Electrical, Mechanical and Mining Engineers.

Mr. Clarence H. Mackay, president of the Postal Telegraph-Cable Company, has given $5,000 to the fund, accompanied by the expression of his interest in the building as a center whose facilities will be available to the various bodies of telegraphers. Mr. U. N. Bethell and Mr. J. J. Carty, members of the committee, have advised it, on behalf of the American Telephone & Telegraph Company, the Western Electric Company, the New York & New Jersey Telephone Company and the New York Telephone Company, that these corporations have jointly contributed $25,000 to the fund, in view of the great benefits that the existence of this new engineering center will confer upon the electrical arts and upon their employes in the widening field of telephone engineering.

Other notable gifts to the fund are $1,200, from Mr. E. W. Rice, Jr., and $500 from Mr. T. D. Lockwood. A number of subscriptions of lesser amounts have been received from the Institute membership at large and in this manner the fund has now reached the total of over $130,000 or two-thirds of the required amount. With the campaign it has already inaugurated, and the plans now maturing the committee is hopeful of having the entire sum pledged before the Institute moves into its new home.

## Water Powers in France.

A very thorough study is being made in France of the condition of the water sources and water powers of the country. A decree dealing with the subject was put forth in December, by the president, adopting a report from the minister of agriculture, increasing the staff devoted to such works. The French minister of agriculture, in his report which drew forth the decree above mentioned, says: "We know the great degree of interest in the utilization of waterfalls for the production of electricity, not only of those great mountain torrents, but also of those of the secondary ranges, and in a certain measure the streams of flat countries. In France the rivers susceptible of being controlled with a view to industrial utilization are very numerous. However, before erecting hydro-electrical works of importance, it is of the highest interest to know the variations in the volume of the stream utilized at various periods of the year. For having neglected this primordial element of information several enterprises hastily realized have given rise to cruel deceptions. During periods more or less long certain concerns have had at their disposition an amount of power greatly inferior to that upon which they counted, and are, therefore, placed under the necessity of making costly transformations in their original installations, and in some cases have been obliged to abandon their plants.

"The factors to be investigated are the surface and direction of the watershed, the mode of culture, the extent of the forests, the geological nature of the soil and subsoil, the intensity and the division of the rains or snows received by the watershed, and in mountainous countries the surface of glaciers which sustain the summer discharge. Your minister of agriculture has instituted a bureau of hydraulogy and great hydraulic forces in our two principal mountain systems—the Alps and the Pyrenees—and he proposes to extend progressively the same studies to the secondary systems and then to the level regions. The two services which now operate have already gathered together a great number of useful elements; but it is of the highest interest in order that they may be utilized to determine the best methods of seeking these elements and to co-ordinate the results obtained. This is a new and important task, which is now confided to a committee of scientific studies."

## The Famous Dalrymple Report.

It will be remembered that Mr. James Dalrymple, manager of the municipal street car system of Glasgow, was brought to this country by the advocates of municipal ownership in Chicago to make a report on the conditions there. Mayor Dunne, of Chicago, got a report, but in some way managed to suppress it immediately. A great deal of interest and curiosity has been aroused as to the document, and until now fruitless efforts have been made to secure a copy of it. Mayor Dunne asserted that Dalrymple went to Chicago as a personal guest and that the report was, therefore, personal property. The Chicago City Council finally obtained a copy of the report from Alexander Walker, Deputy Town Clerk of Glasgow. The report in effect is against the municipal operation of street car companies in Chicago unless it has become impossible to reach an agreement with the companies now operating lines in the city streets.

Mr. Dalrymple suggests that an effort be made to come to terms with the companies now operating street car lines in the city, and suggested that if that is not possible there is only one thing to do, which is to start a new line as fast as the franchises under which the companies are now operating, expire. The report then declares that most of the present equipment of the companies should be relegated to the scrap heap, and a time fixed within which the lines should be placed in perfect condition. Then a franchise should be granted for, say, twenty years, with the city having the right to take possession at the end of five-year periods. The report concludes as follows:

"I should be very sorry indeed if you were forced to take such a step as starting new lines when the franchises of the present companies expire, because, speaking generally, I should say from my knowledge and experience of what it means to operate a municipal street railway system, that the municipalities of the United States are not yet quite ready successfully to undertake this work."

Mr. Dalrymple strongly recommends the overhead trolley for motive power, saying that to "install the underground trolley in any extent would, for various reasons, be a scandalous waste of money."

## Co-operative Electrical Development.

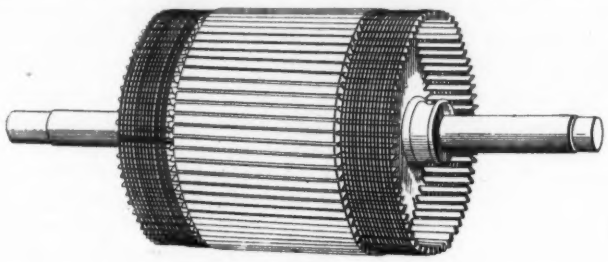
Mr. J. R. Crouse, of the Co-operative Electrical Development Association, announces that it is proposed to hold a meeting in New York City for the different electrical interests for a consideration of the work of the Association. This meeting will be held on Friday, March 23, at the Imperial Hotel. Substantially every well defined line in the industry will be represented, including the larger manufacturing companies, representatives of different groups of electrical manufacturers, such as incandescent lamp, rubber covered wire, etc., the president of the National Electric Light Association and a co-operating committee of three appointed at their last meeting, representatives of the trade papers, the counsel and committee of the Electrical Jobbers' Association East and West, the president of the National Electrical Contractors' Association, their co-operating committee, advertising agencies specializing in the electrical field, a committee of Electrical Salesmen's Association, etc. The session will conclude with a dinner in the early evening.

## Cooking by Electricity.

With a view to introducing electricity for domestic purposes President Maritt, of the Kokomo, Marion & Western Traction Company, has secured Mrs. A. V. Sanborn, of St. Louis, to deliver lectures on cooking by electricity and to demonstrate to the farmers' and villagers' wives how successfully and economically electricity can be used in the home. The company believes that when people living along the line acquire a knowledge of the comfort, convenience and economy of electricity, a considerable demand for the current will be created, and incidentally quite a market for miscellaneous apparatus.

## Rotor for Induction Motor.

In order to provide improved facilities for cooling the secondary windings of an induction motor, Mr. E. J. Willis, according to a patent issued February 8, allows the rod con-

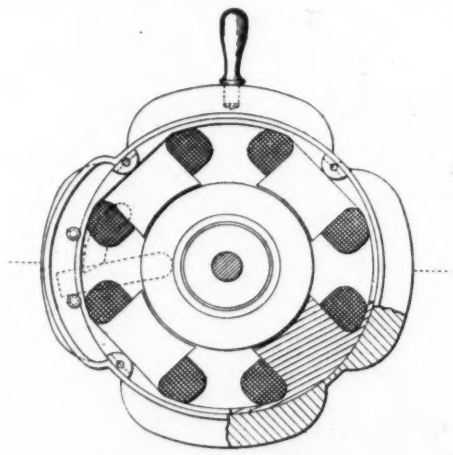


ROTOR.

ductors to extend longitudinally beyond the ends of the rotor core, and interconnects the ends of rods by means of naked wires placed circumferentially in notches cut in them. The construction is clearly indicated in the illustration.

## Variable Speed Direct-Current Motor.

The accompanying illustration shows a method of obtaining speed variation in a shunt-wound, direct-current motor as disclosed in a patent issued February 7, to Mr. C. A. Eck. The motor is provided with an adjustable yoke between the poles whose sectional area can be varied. When the yoke is adjusted to one position, the magnetic lines of force will flow through



VARIABLE SPEED MOTOR.

that portion of the yoke having a large cross-sectional area, and when adjusted to another position the lines will flow through that portion of the yoke whose cross-sectional area is smaller. It is seen, therefore, that there is a change in the reluctance of the magnetic circuit and a corresponding variation in the field flux with constant field current, but there is no change in the dimensions of the air-gap or of the cores of the poles.

## Canadian Electric Railways.

There are 793 miles of electric railways in the Dominion, a gain of only 36 miles over the preceding year. The capitalization is $61,033,321. The gross earnings for 1905 were $9,357,-125, the operating expenses $5,918,194 and the net $3,438,931. The passengers carried were 203,67,317, or 2,777,319 more than in 1904-5. The freight handled was 510,350 tons, a gain of 110,-189 tons. The total run was 45,959,101 car miles. The killings numbered 56, and 1,269 people were injured. In Montreal 67,-297,268 passengers were carried; in Toronto 65,792,792; in Winnipeg 11,255,967, and in Ottawa 9,328,690. The Vancouver, Victoria and New Westminster system in British Columbia handled 10,352,410 passengers.

## Meeting of the Illuminating Engineering Society.

The meeting in New York last week of the Illuminating Engineering Society scored a notable success, the attendance exceeding 150. At the meeting it was announced that although a systematic canvass for members has not been started, the membership to date is 192, of whom about a half reside distant from New York. The secretary stated that arrangements are being made for the organization of branches of the society at Boston and Chicago, and that the papers of the evening would be discussed in Boston and Chicago the following Friday. The New York meeting will be held on the second Friday of each month, unless there are special reasons for changing the date. The programme for next meeting, which will be held on Thursday, April 12 (the 13th of April being Good Friday), is a general discussion of the subject of interior illumination, which will be opened by several short introductory papers.

The surprise of the evening was the character of the paper by Mr. Victor A. Rettich, a gas engineer, on the inverted gas mantle lamp. It was expected that the paper would present the claims in favor of the inverted gas burner, which at present is attracting so much attention in this country and abroad. Instead it is as severe an arraignment of the new device as its most unrelenting antagonist could desire.

Below will be found abstracts of the several papers presented and of the discussion to which they gave rise:

### ILLUMINATING ENGINEERING FROM THE ARCHITECT'S STANDPOINT.

In a short paper with the above title, Mr. W. S. Kellogg gave a brief discussion of artificial illumination from the architect's standpoint. He expressed his belief that the intrinsic brilliancy of the commercial illuminants is too great and that globes must be employed to render the light less objectionable. The present trend of development in illuminants is towards greater brilliancy at the same or an increased consumption of electrical energy. It seems desirable from all points of view not to increase the illumination from the source of light at a given cost for energy, but rather to decrease the cost for electricity while maintaining or even decreasing the illumination. The author thought that the only logical method of rating lamps for illumination is by the mean spherical candle-power, and that other methods merely lead to confusion. It is desirable that both the lamp itself and the light obtained from it should harmonize with the surroundings. It is the duty of the architect to study the requirements of his customers and then to select the lamp which most nearly corresponds with those requirements. The position of the lamp, its color, and the color of the light produced, are of prime importance, while frequently efficiency is of secondary consideration.

### THE INVERTED GAS MANTLE LAMP.

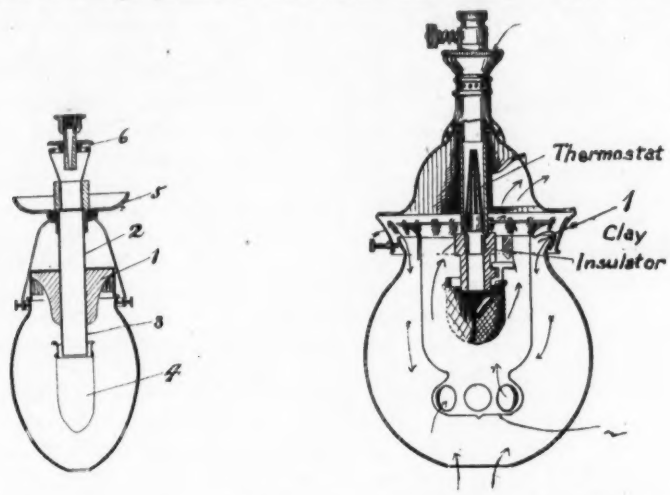
The paper on this subject, presented by Mr. Victor A. Rettich, enumerates the defects of, and objections to, the inverted gas lamp, as follows:

1. Dangers of falling particles. 2. Carbonization. 3. Flashing back. 4. Delicacy of mantle suspension. 5. Flickering light at low pressure. 6. Discoloration of chandelier arms. 7. In many cases a difficulty in attaching lamps so that they will be gas tight when set in the required direction. 8. Methods of gas regulation are too coarse. A much more delicate way is required. 9. Liability of breaking mantles when removing glassware. 10. Variations of diameters of globe rings, so that glassware is not interchangeable with different makes of burners. 11. Variations in means of affixing mantles to burners. Manufacturers should get together and adopt one standard type, though each is naturally trying to protect his future trade in renewals. Still the public ought to be considered if the lamp is to become popularized. 12. Too much heat thrown off in proportion to the amount of gas used.

Mr. Rettich stated that after a long discussion at a recent convention in England, the verdict was that the inverted lamp in its present form would not be a success, and no suggestions were put

forward as to its improvement. Where a light gas of low candle-power is supplied at a high pressure, the inverted burner may give good results, but with New York gas the problem is a very difficult one to solve. During a recent visit to Europe he was told that the sale of the inverted lamp is something enormous, but he failed to see that even a small percentage of the burners in use were of the inverted type, and he cannot see that the burners in the present form are going to be a permanent addition to gas lighting appliances. It has been on sale in Europe for the last four or five years and yet to-day a tremendous majority of burners are of the upward type. While admitting that the inverted burner permits of graceful outlines and designs, he said that so far the public has not taken to the designs in which the mantle is so placed and the globe is so shaped as to present the appearance of an electric incandescent lamp. The inverted burner, he stated, has recently been condemned in New York City by the Board of Fire Underwriters on account of fires started from it, and many billiard tables, etc., have been charred by red-hot carbon falling through the open base of the globe. As to efficiency, he said that while there can be no doubt that with the inverted burner this is much greater than with the incandescent lamp, still the light is so brilliant and glaring that it has to be toned down by ground glass or opaque shades so that the actual candle-power that is utilized is small compared with that of the source.

The paper was illustrated by a large number of sketches showing different types of the lamp. The earliest patent cited on the inverted burner is dated 1895, but the patents on the forms now in use date from 1901 and later. Fig. 1 shows what is stated to be the pioneer of the present lamps, the inventor of which was an Austrian. The principal point is the porcelain cone, 1. The burner tube, 2, is of a poor conducting material, the burner head, 3, being made of metal. The mantle is shown at 4, and 5 is a deflector to keep the products of combustion from the air ports, 6. Fig. 2 represents what is stated to be the latest inverted burner to enter the field. The inner and outer globes may be used either together or singly. The air intake may be above the mantle as at 1, in which case an entirely enclosed outer globe may be used. The bottom (2) of the inner globe is closed in order to catch any falling particles. The particular feature of this type is the employment of a thermostat which is arranged in a direct line with the flow of gas. When the burner is cold the narrow ends of the thermostat will be bunched together, forming a solid cone




Figs. 1, 2 and 3.—Details of Inverted Gas-Mantle Burners.

Fig. 4.—Inverted Gas-Mantle Fixtures.

Fig. 5.—Inverted Gas-Mantle Fixtures.

and offering resistance to the mixed air and gas, thus permitting of lighting without flashing back. As soon as the burner is thoroughly warmed up the action of the heat on the thermostat fingers will cause them to open and lie flat against the inner surface of the globe, thus offering no obstruction to the descending gas and permitting it to take a full complement of air. Fig. 3 shows the type of inverted burner that has been used with very satisfactory results in railway lighting. A peculiarity of this type is the way in which the mantle is attached; there is no opening between the mantle holder and the burner tip, the mantle being continuous with the tube, so that no products of combustion can escape. The combustion of the burner is stated to be absolutely perfect, and consequently no carbonization of the mantle follows. Mr. Rettich ascribed the great success of this burner to the fact that it is used with the Pintsch gas system, which employs the great pressure of about 28 in. of water.

### THE LUMINOUS ARC LAMP.

In the first part of his paper with the above title, Mr. E. L. Elliott sketched the progress of electric arc lighting from the discovery of the electric arc by Sir Humphry Davy to the present time. In taking up the subject of the paper he criticised the use of the term "flaming arc" and advocated that for the sake of scientific accuracy it would be far better to use the term "luminous arc" since this word is exactly descriptive.

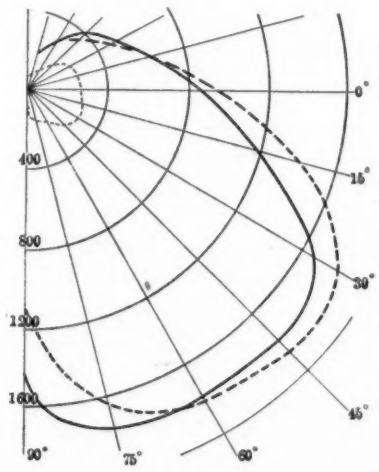



FIG. 6.—LIGHT CURVES OF LUMINOUS AND ENCLOSED ARC LAMPS.

By the introduction into electrodes of substances having a high light radiating power, such as salts of the calcium group of elements, the electric arc itself is rendered highly luminous and becomes the principal source of light, instead of the heated end of the positive carbon as in the case of the ordinary arc lamp. The hot gases generated by the volatilization of the salts in the carbon furnish a path of less resistance than air for the passage of the current and thus permit the electrodes being drawn much further apart, producing an arc 1½ in. to 2½ in. long. The light thus produced is, with the calcium salts, of a golden tint hardly distinguishable from the color of light of ordinary flames and incandescent electric lamps. This yellow color of light is for purposes of exterior illumination, a decided point in its favor, having a much greater penetrating power than the blue and violet light from the open arc. For lighting foundries, iron mills, railway yards or any other large enclosure where smoke abounds, this is of particular advantage.

While in the past electrodes to produce white light have been less efficient than those producing yellow light, at the present time carbons giving a white light of remarkably fine quality are made. It is claimed that the white light thus produced is the nearest approach to sunlight of any of the commercial light-sources.

In efficiency as a light producer, the luminous arc is revolutionary. Comparative measurements made by the Electrical Testing Laboratories with a luminous lamp producing the yellow light, and with an enclosed arc gave the following results:

| | Luminous arc. | Enclosed arc. |
|---|---|---|
| Mean amperes | 8. | 5.1 |
| Mean volts at arc | 45. | 91. |
| Mean watts at arc | 360. | 413. |
| Mean spherical c.p. | 1020. | 232. |
| Mean lower spherical c.p. | 1560. | 260. |
| Wattes per m.s.c.p. | .353 | 1.78 |
| Watts per m.h.s.c.p. | .265 | 1.59 |

In actual light production the luminous arc is, therefore, practically five times as efficient as the enclosed arc. The lamps tested were run on direct current, and were fitted with opaline globes of practically equal density.

While the price of luminous arc electrode is higher than the price of the best pure carbons, the cost per candle power hour figures out exactly the same. The smaller lamps run ten hours with one setting of carbons, and the larger lamps 15 hours.

Fusible matters introduced into arc electrodes have the tendency to form drops of slag, which interfere with the operation of the lamp if the carbons are placed one above the other. It was, therefore, found necessary to resort to an arrangement of the carbons side by side and inclined toward each other at a slight angle, thus reverting to the arrangement of the Jablachkoff candle, the earliest commercial form of arc lamp. This necessitates the use of an electromagnet placed above the arc to give a downward curve and prevent its running up the sides of the carbon. This arrangement has the advantage of giving a distribution entirely free from shadows underneath. In practical construction a concave porcelain plate or cup is placed immediately above the arc, which protects the mechanism, steadies the arc, and acts as a reflector of the upward rays.

The distribution of light from the lamps now on sale in this country is practically the same as from the enclosed arc when used with opaline globes. A comparison of the two curves from the tests above referred to is shown in Fig. 1. Both curves refer to vertical planes, one passing through both carbons and the other at right angles thereto. The dotted curve of small area represents the light flux of an enclosed arc. For exterior illumination a somewhat broader curve would be rather more desirable.

Owing to the much greater size of the light-source the intrinsic brilliancy, even with the lamps giving much higher total candle power, is far less than with the ordinary arc, except where the latter is diffused with very strong diffusing globes. With the carbons giving a white light the efficiency is said to be reduced about one-half; but even in this case the efficiency is more than twice that of the enclosed arc, and the quality of the light superior in being free from the excessive blue and purple rays.

On account of its greater length, the arc is naturally very sensitive to air currents, and it is therefore necessary to protect it from drafts. Since there is also some vapor generated, which must be allowed to escape, provision is made for a restricted access of air and the discharge of the vapors. This is accomplished by providing a small inlet at the bottom of the globe and a corresponding protected outlet at the top.

Lamps are made to run on either direct or alternating-current circuits, and on frequencies of 60 cycles and upward. As they require about 45 volts to the arc, they are run two in series on 110-volt circuits. The mechanical and electrical operation of the lamps now sold seem to be entirely satisfactory. Thus far only lamps of foreign manufacture have been introduced here, the general design of which is practically the same. One is manufactured in Germany and the other in England. The lamps sell for about $50 each.

As the real virtue of the lamp lies in the composition of the carbons, these are naturally claimed by the different manufacturers to be either protected by patents or are kept secret. As the fundamental patents have long since expired, it seems unlikely that any monopoly can be maintained in this respect. The most serious objection that can be urged against the lamp at present is the greater amount of attention required. It is in this line that efforts are at present mainly directed toward improvement, particularly toward combining the long life of the enclosed arc with the efficiency of the luminous arc. In view of the enormous increase of efficiency obtained, the improvement in the color of the light, its steadiness, and naturally advantageous distribution.

together with the rapid improvements that have been made within the last few years, it is safe to predict that the luminous arc lamp marks an epoch in electric illumination.

DISCUSSION.

The several papers of the evening were discussed together. Prof. Edward L. Nichols, of Cornell University, in opening the discussion, referred to the deep interest which the new society has aroused among the many classes of engineers, architects, builders, dealers, physicists and all persons in any way connected with illumination. He expressed his belief that the society will undoubtedly prove a success. Artificial light was used long before history began, but even at the present time very little is known as to the proper use of illumination. Many problems are yet in dispute. The society should insist on correct methods and satisfactory results will be obtained. It should educate the people to judge of illumination by the effect produced, and it should also educate the engineers and architects to a proper appreciation of the fundamental features of illumination. He thought that the organization of the Illuminating Engineering Society would mark an epoch in the art, by bringing together for the good of each all persons interested in illumination.

Mr. Geo. G. Ramsdel agreed with Mr. Rettich in regard to some of the minor defects of the inverted gas mantle lamp, and expressed the opinion that while the paper of Mr. Rettich contained much of truth, it contained much more of error. The inverted lamp is exceptionally free from defects, if its age be considered. It is not yet perfect, but even now it is in good form and is sure to be a success. To just the same extent as Mr. Rettich was pessimistic, he himself was optimistic. Mr. E. C. Brown remarked that about three year ago he obtained the first inverted gas mantle lamp to be brought to this country. Even at that date the lamp was extremely satisfactory; the mantle was not destroyed in the short time mentioned by Mr. Rettich, but it burned for eight months. He felt that the inverted mantle lamp has come to stay and that it is a success at the present time, while the few remaining defects can easily be overcome. In reply to a question by Mr. Rettich, he stated that the particular lamp to which he had referred is not now in use because the mantle had been destroyed. A second inverted mantle lamp is giving good service, but lamps of the older type are yet being used by him.

Dr. C. H. Sharp discussed the physical relations which exist between the incandescent-mantle lamp and the flaming-arc lamp. In each lamp the light comes largely from a substance which ordinarily is not luminous. Thus, in the flaming arc the vapor is rendered luminous by the passage of the electric current, while in the mantle lamp the substance of the mantle becomes luminous when placed in the gas flame. In the former lamp there is a consumption of the substance giving the illumination, while in the latter the luminous substance is permanent. The exact cause for the increase in illumination when a mantle is placed in the gas flame has never yet been determined. It is known, however, that only certain definite proportions of the elements forming the mantle will give the desired illumination. When each element is used singly, the desired effect is entirely lacking. Rubens, who studied the distribution throughout the spectrum of the energy radiated by the mantle, found that the radiation is confined largely to the visible portion of the spectrum, and is very low in the heat range, so that the efficiency of the luminous radiation is extremely high. The effect of combining the various components of the mantle seems to be to confine the radiation to the visible portion of the spectrum. He expressed the opinion that the flaming arc is too brilliant to be substituted directly for the older types of arc lamps. The lamps should be more widely separated and should be placed higher from the ground.

Prof. Nichols ventured what he termed a "guess" as to the high luminous efficiency of the gas mantle. Perhaps the increase in illumination is due to the luminescence of the mantle at the temperature produced by the gas flame. Each luminescent substance exhibits this property at a definite temperature; some at the low temperature of liquid air, others at ordinary temperatures, and yet others at much higher temperatures. The mantle may be considered as a solid in solution which is rendered luminescent at the particular temperature to which it is subjected. The energy curve of the radiation throughout the spectrum seems to show that this theory is correct. It is difficult to ascertain just how much of the illumination from the mantle is due to the luminescence of the substance, on account of the high temperature which simultaneously renders the mantle incandescent. It may be possible to discover materials other than those used in the mantles which are luminescent at certain temperatures, and thus to produce various color effects. This is an inviting field for investigators.

Mr. W. D.'A. Ryan, of the General Electric Company, stated that the weakest features of the flaming arc lamp are the short life of the pencils, the high brilliancy and the poor distribution of illumination. Distribution curves which he displayed showed that only 16 per cent of the total illumination is given off in the range between 0 and 20 degrees below the horizontal, that is, within the useful range for street illumination. When globes are used the light is enormously decreased. For street illumination, distribution is of greater importance than efficiency, as is shown by the fact that the enclosed arc lamp has superseded the open arc, although its efficiency is much lower, merely because a large portion of the light is given off in the useful range. He considered that the very best arc lamp with reference to distribution is the G. E. "Magnetite" lamp, which gives 55 per cent of the light between 0 and 20 degrees below the horizontal.

## CURRENT NEWS AND NOTES.

*JERSEY TROLLEY FREIGHT.*—The New Jersey Legislature has passed the bill permitting trolley companies to carry freight and a limited franchise measure granting certain leases to public utility companies for a period of 20 years.

*N. E. L. A. TRANSPORTATION.*—Mr. G. F. Porter, master of transportation of the National Electric Light Association, announces that the Trunk Line Association and the New England Passenger Association have authorized a rate of fare and one-third, on the certificate plan, from points in their respective territories to Atlantic City and return, for delegates and their friends attending the twenty-ninth convention of this association, to be held at Atlantic City, N. J., June 5 to 8, inclusive. Negotiations are under way with the other associations and it is hoped that the same rate will be obtained from them.

*PERSONAL INJURY LITIGATION*, so expensive to public service corporations, is one of the things municipal ownership advocates think about rarely. It is, therefore, interesting to note that such litigation that will cost the city millions of dollars every year under the municipal ownership of traction lines is predicted by City Attorney John F. Smulski, of Chicago. He sounds the warning in his annual report to the City Council, and recommends amendments to the Mueller law that will remove the impending danger. After calling atention to 700 lawsuits for personal damages filed against the city last year which were settled at a total cost of $400,000 to the city, Mr. Smulski expresses the belief that the damage suits would be increased more than twelve fold under municipal ownership. "The street railways of Chicago," said he, "have filed against them claims of every description, possibly to the number of 10,000 annually. I have it on good authority that these companies pay out in defraying expenses of their claim and law departments to charge of personal injury litigation, the settlement of claims and the payment of judgments recovered, upward of $2,000,000 annually. Knowing from past experience what success personal injury professionals have had against municipalities, I believe that the amount of claims and judgments recovered in the case of municipal ownership and operation of street car lines would far exceed the sums paid out by the present street railway corporation, which have reduced the system to a science."

*CHICAGO SEEKS ADVICE.*—The Chicago City Council Committee on Telephone Rates is advertising in New York papers for the opinions of the local telephone subscribers as to the measured rate system of service. The Western metropolis is proposing to adopt a new telephone rate ordinance and thus seeks information on the subject.

*DESTRUCTIVE AUTO FIRE.*—No fewer than 50 or 60 electric automobiles were destroyed in a fire that broke out on March 10 in the barns of the New York Transportation Company in this city. Several hundred machines were stored in these quarters, for the extensive public service system maintained by the corporation, whose vehicles are in constant demand and have been extraordinarily busy this winter.

*BUYING A CATARACT.*—It is announced from Spokane, Wash., that Mr. Jay P. Graves has paid $77,000 for the falls of the Columbia River at Kettle Falls, Wash., 75 miles north of Spokane. The river there can produce 100,000 hp at extreme low water and the falls are said to be the largest in the United States with the exception of Niagara and the Shoshone Falls in Southern Idaho. Mr. Graves is expected to install an electrical generating plant to supply his Inland Empire Electric Railway radiating out of Spokane, and also to supply the mines and smelters in the boundary district of British Columbia.

*AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.*—The next regular meeting of the American Institute of Electrical Engineers will be held Friday evening, March 23, at 8.15 p.m., in the assembly room of the New York Edison Company, 44 West Twenty-seventh Street. The following papers will be read and discussed: (1) "Some Features Affecting the Parallel Operation of Synchronous Motor-Generator Sets," by J. B. Taylor, railway engineering department, General Electric Company, Schenectady, New York. (2) "Notes on the Design of Hydro-Electric Power Stations," by D. B. Rushmore, of the General Electric Company, Schenectady, N. Y.

*BOUNDARY OF YOSEMITE PARK.*—The California Congressional delegation at Washington has been unofficially advised that a favorable report will be made by the Secretary of the Interior on the plan to change the boundary of Yosemite National Park in order to permit the construction of electric railways on an even footing in competition for Yosemite Valley traffic. The southwestern boundary at present prevents Huntington's line from Fresno, Cal., from approaching as closely to the valley as does the Merced route. It has been demonstrated to the satisfaction of the Department that no scenic features or valuable forests would be excluded from the Park by changing the boundaries, while the public interest would be served by giving all railroads an equal chance to compete. Upon receipt of Secretary Hitchcock's report, an effort will be made to secure the passage of a bill making the proposed change in the boundary.

*TROLLEY FREIGHT* bids fair to assume considerable importance in New England. The Massachusetts Railroad Commissioners have given the Old Colony Street Railway system of the Massachusetts Electric Companies authority to carry freight and express matter over its lines between Boston and Fall River. The management has been preparing for this service and has secured the local rights to the south of Boston and ordered cars for this service. Mr. George Dumford, who built up a large freight and express business for the Utica Street Railway Company, has been appointed "superintendent of freight and express" with headquarters at Brockton. The new service will be opened inside of thirty days. Express cars of 20 tons capacity each and two coal cars have been secured for service on the Boston & Northern system. These cars will have running rights over the Boston Elevated lines, and terminals in Boston will be secured. Hereafter the Boston & Northern will transport all its coal from tidewater to Lawrence and Woburn and other inland points for the company's power needs at a considerable saving. Practically the only expense will be that of labor.

*THE PROPOSED MONORAIL.*—The Brooklyn Engineers' Club, of Brooklyn, N. Y., was entertained recently by F. B. Behr, the English engineer, who in an illustrated lecture explained the principles of the monorail system, which he is advocating as a means to relieve some of the congestion on the local street railways. With stereopticon pictures Mr. Behr showed interiors of the cars which would be run on his road, sections of the experimental track in Germany, and drawings giving the mechanical construction of the cars. Most of the lecture, which dealt with local conditions, had to do with the line Mr. Behr proposes to run down Fourth Avenue, Brooklyn, to Coney Island, starting from the Interborough terminus at Flatbush Avenue.

*STATE METER EXAMINATION.*—A bill said to have plenty of politics behind it has been introduced in the New York Legislature. It gives the State Gas and Electric Commission power to inspect all gas and electric meters and to affix the commission seal guaranteeing their efficiency. Lighting corporations may not install meters unless they have been inspected. The bill also provides that a testing apparatus shall be kept on the premises of the consumer. A consumer may demand a test in his presence at any time. If the test by the company be unsatisfactory in his opinion he may ask for a test by the State Commission. This is one newspaper comment: "Behind this bill is said to be a movement to take from Jastrow Alexander his power as State Inspector of Gasometers and transfer them to the State Commission. Alexander is Republican leader of the Twenty-sixth New York District, and, like many other Republican district leaders, he is waiting to see which way the wind blows before he ties himself to either State Chairman Odell or Chairman Parsons." What a pretty picture is presented!

*LODGE AND THE MEDIUMS.*—The deep interest taken by Prof. Lodge in mediumistic performances is well known and is brought to notice again in the following cable dispatch from London of March 10: "Sir Oliver Lodge and other prominent scientific men who are interested in the occult were to have held a series of experiments next week with Charles Eldred as a subject. Eldred for the last six months has been creating a great stir in spiritualistic circles as the most gifted medium in the country. He has now been exposed by fellow spiritualists, one of whom, a man named Braily, declares that the spirits informed him that Eldred was an impostor. After a séance Eldred left in Braily's house a chair which he had used in the cabinet from which the 'spirit forms' emerged. Braily's examination resulted in the discovery of a keyhole hidden in the plush covering a hollow seat, which contained spirit faces, masks, wigs, diaphanous drapery, an electric lamp, powder, etc. At the next séance Braily denounced Eldred as an impostor and the latter confessed. Sir Oliver Lodge and the other scientists are thus deprived of their experiment. The fact that Braily is also a medium suggests professional jealousy."

*DISTINCTIVE LAMP POSTS.*—In an article discussing art in the street, in the March *Century*, Mr. Sylvester Baxter says: "Street furnishings like lamp posts, in their numerous repetitions, perform an important decorative function. We know that in decorative design the repetition of ornament is an æsthetic principle, producing its impression by the reiteration of a pleasing figure. But long-continued uniformity produces monotony; fatigue follows visual restfulness. Therefore, even when manufacturers produce good designs, it is undesirable that these should be alike everywhere, in town after town, for the eye would tire of seeing the same thing in all places. Hence each municipality would do better to obtain something distinctive. Indeed, the same thing should not be repeated all over one city; the standard pattern ought to vary with different districts, and perhaps with different streets. Locally individual significance might well be imparted to these things by embodying in the ornament of such furnishings some device, like a municipal seal, or arms, that in design would symbolize a distinguishing character of the place, as in site, trade or staple industry." The practice or suggestion has been observed in some of the more conspicuous arc lighting posts and standards in Europe.

*MUNICIPAL PLANT ASSOCIATION.*—To protect the interests of municipal plants in Massachusetts, an association has been formed, with a membership drawn from the mayors and selectmen of towns and cities operating such plants, together with the managers or commissioners. This body has perfected its organization with Mayor N. P. Avery, of Holyoke, president; Col. Barrett, of Concord, vice-president; J. C. Norcross, manager of the Hudson City lighting plant, secretary and treasurer. The executive committee comprises these and Messrs. King, of Peabody, and Lyon, of Manfield. Meetings are to be held at the call of the executive committee, and legislation affecting municipal ownership is to be watched.

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*MUNICIPAL OWNERSHIP FAILURE.*—At a meeting of the Commercial Club in Boston on February 28, an especially interesting address was delivered by Mr. Everett W. Burdett. He described in detail the conditions that have followed the introduction of municipal ownership in British cities, and held that muncipal ownership had few beneficial results to show. He brought out the point that the discussion of municipal ownership had developed a considerably widespread disposition among the voters to assent to any scheme, however extravagant, in the expectation that some good must result. This should serve to remind us of the warning of the exponents of the old Jeffersonian democratic view, that man's best benefits are those which he earns by his individual exertions and not through the factitious aid of government.

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*LONDON TRAFFIC.*—Some very interesting figures are given in the report of the London Traffic Commission for 1905 just out. The total number of passengers carried on the underground and surface railways and omnibuses of London during the year was equal to three-quarters of the population of the whole world. The lumbering old omnibuses carried passengers equal to the whole population of the United Kingdom seven times over. At the busy time of the day 642 omnibuses pass the Bank of England in the heart of the city district in an hour, a procession two miles and a half long. There are in London 3,471 horse and already 307 motor 'buses. A passenger in Oxford Street, leading east and west, has the choice of twenty-seven omnibus routes to different parts of London. This is said to be a convenience unexampled in any other city.

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*A THOUSAND TELEPHONES ORDERED OUT.*—More than 1,000 printed notices, signed by Seattle, Wash., business men and professional men, ordering the removal of the Sunset telephone from office or residence, and hundreds more of these notices sent to the committee in charge are the immediate results of a mass meeting held in the Grand Opera House February 21, according to a Seattle report. If the individual signers abide by their determination as expressed in the printed notice, nearly 2,000 Sunset telephones will be removed on or before the first day of August, and in their places will be installed telephones of the independent company. By adopting the report of the committee in charge, the mass meeting took the above action. This report embodying the results in brief of the committee's investigations of the local telephone situation, was presented by W. T. Dovell. Disclaiming any enmity or ill feeling against the Sunset system or its management, the report was a severe arraignment of the service the company has given to Seattle for years past. The independent system was credited with fair play and good management.

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*ELEVATORS AND ANTI-TRUST LAW.*—The Department of Justice at Washington announces that an anti-trust suit has been brought in San Francisco by the Government against 31 elevator concerns, including the Otis Elevator Company. The department says: "The companies named as defendants comprise the principal elevator companies of the United States, but the operations specifically complained of have been carried on mainly in California and the States and Territories west of the Rocky Mountains. It is charged that these companies make and sell at least 80 per cent of all of the elevators used in that territory, and that they have entered into a combination among themselves to control and enhance the prices at which elevators are sold. That in order to make the combination effective the Otis Elevator Company has acquired the whole or a majority interest in the businesses of all the other defendants, although said defendants are still being operated as apparently separate and independent concerns. The bill prays that the defendants be perpetually enjoined from carrying out their illegal combination and from further agreeing and combining together to control the trade and commerce in elevators and to deprive the people of the several States in the United States of the benefit in rates and prices derived from free and unrestrained competition in said business."

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*NEW LONDON SUBWAY.*—A special cable dispatch from London of March 10 says: "The Baker Street Waterloo "tube," one of the late Charles T. Yerkes's group of railroads, was opened to-day. This is the most important link in the solution of the city's traffic problem. The new artery, the length of which is five and one-quarter miles, runs north and south, traversing all the older lines, with which it is connected by subways, thus enabling passengers to reach within a short distance of any point in the metropolis. The construction of the road was begun in 1898 under the auspices of the late Whitaker Wright's group of roads, and subsequently was purchased by the Yerkes-Speyer interests. Speaking at the luncheon in celebration of the opening of the road, Edgar Speyer, the successor of Mr. Yerkes in the chairmanship of the system, said he hoped that by the spring of 1907 the entire underground system would be working satisfactorily. These lines, he believed, would supply a great want, do much to solve the great traffic problem and fully justify their existence. In some places the new tube is 155 ft. below the surface of the ground and 35 ft. below the bed of the River Thames." The time of the first public train over the route was twelve minutes. The new two-penny tube is superior to the other tubes in construction, is well ventilated and lighted and has stations with colored tiles of a distinctive tint, easily recognized. This crosscut line will become more important in the course of six months, when the extensions are finished to the Marylebone and Paddington stations and additional connection made with Southeastern London.

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*ELECTRICITY AT OIL WELLS.*—In an interesting article by Mr. J. E. Walsh in *Mines and Minerals* for March, reference is made to the use of electricity around European oil wells as a preventive of fire as well as for oil drilling and pumping. He says: "The use of electric motors for driving oil drills and oil well pumps has extended rapidly in parts of Europe where German and French engineers have studied the problem. To a European engineer the waste of Americans seems often nothing less than a crime, and it is impossible to understand our point of view. When we consider that the world's demand for petroleum far exceeds the supply, any waste of the fuel appears all the more obnoxious. The extended use of internal combustion engines and the popularity of the automobile are factors that are working steadily toward a more general use of refined petroleum, and there is little doubt that within a decade the demand for the oil will be more than sufficient to exhaust the native supply. The suppression of the fire risks in the oil regions first led engineers in Russia to experiment with electric motors. The fires and explosions at the mouth of the wells were almost as great in that country as in this. The elimination of the fire risk in the oil regions was not the only consideration, however, which induced the engineers to adopt electric power. The wells in nearly every field are scattered over a wide area, necessitating the distribution of steam pipes over a great radius or the installation of separate generating units. This was a costly method of operating. In some cases the cost of power was so great as to make profitable oil mining impossible except in regions where the flow was abundant. For each paying well a dozen would be operated at a loss."

## The Largest Sub-Station in the World.

TORONTO, CANADA, now has the largest sub-station, in point of capacity, in the world, and this sub-station is to receive 30,000 kw at about 60,000 volts from Niagara Falls. Energy for the electric light and power system at Toronto, and also for the street car lines in and about the city, is to be supplied by the Toronto & Niagara Power Company, which has built this sub-station and the 75-mile line from the Falls, of which it is the terminal. At present two of the four 60,000-volt, 10,000-hp circuits that are destined to enter this sub-station have been completed over a line of steel towers from the Falls, as previously described in the ELECTRICAL WORLD, and a large part of the transforming equipment for these two circuits has been erected in the sub-station. Each circuit is to receive 60,000-volt, three-phase, 60-cycle current and to deliver 10,000 electric hp with a line loss of 10 per cent. At this terminal or sub-station the 60,000-volt current is transformed to 12,000 volts, three-phase, for distribution to the several lighting and railway stations about Toronto.

Three transformers are provided for each transmission circuit at the Toronto terminal station, and each of these transformers is rated to step down 2,400 kw from 60,000 to 12,000 volts. For each transmission circuit the total transformer capacity at the terminal is thus 7,200 kw. As the terminal is designed for four of the transmission circuits, the combined rating of their connected transformers will thus be 28,800 kw, a capacity that is probably greater than that of any other sub-station in the world to-day. Though the four 60,000-volt circuits will be connected to only twelve of these 24,000-kw transformers at any one time, provision has been made at the Toronto terminal for 15 units of this capacity, so that there will always be one set not in use. Each group of three transformers is connected in delta at both the 60,000-volt and the 12,000-volt windings, so that each transformer has the full line pressure at its high-tension coils.

Current enters the sub-station at about 60,000 volts and leaves it at about 12,000 volts, passing through a choke coil, current transformer, two 60,000-volt oil switches, 60,000-volt bus-bars, a step-down transformer, two 12,000-volt oil switches and 12,000-volt bus-bars, on the way. On each side of each 12,000-volt oil switch and on each side of each 60,000-volt oil switch, except where a 60,000-volt oil switch leads directly to a transformer, there is a disconnecting switch in each conductor of each three-phase circuit, so that each conductor from the 60,000-volt entry to its transformer includes three connecting switches, and each conductor from its transformer to the 12,000-volt exit includes four such switches. From this arrangement of switches and bus-bars it results that each 60,000-volt transmission circuit may be directly connected with either group of three transformers alone, or may be connected to two or more groups of transformers in parallel.

On entering the sub-station each conductor of the 60,000-volt circuits passes into a tee connection that leads to a disconnecting switch and lightning arrester at one side, and through a disconnecting switch, choke coil, current transformer, oil switch and disconnecting switch to a short bus-bar from the other. Each of these 60,000-volt conductors, disconnecting switches and choke coils is mounted on three-part porcelain insulators, like those outside on the steel towers of the transmission line. Each insulator has three petticoats, the highest of which is 14 in. in diameter, and is 13¼ in. high and mounted on an iron pin. For a disconnecting switch two of these insulators are used with their centers 24 in. apart, and a metal cap cemented to the top of each carries the clips.

The lightning arrester to which each conductor of a 60,000-volt circuit is connected contains 240 air-gaps between brass cylinders and 60 carborundum rods in series between the conductor and the earth, and is mounted on insulators like the above. In the choke coil that follows the first disconnecting switch in each line conductor after it enters the sub-station, there are 19½ turns of copper wire with a diameter of 0.46 in. The current transformer, carried by each of two conductors in a 60,000-volt, three-phase circuit, is 6½ in. long and 6 in. in diameter, in the enclosed part, and has 16 in. between its high-voltage terminals.

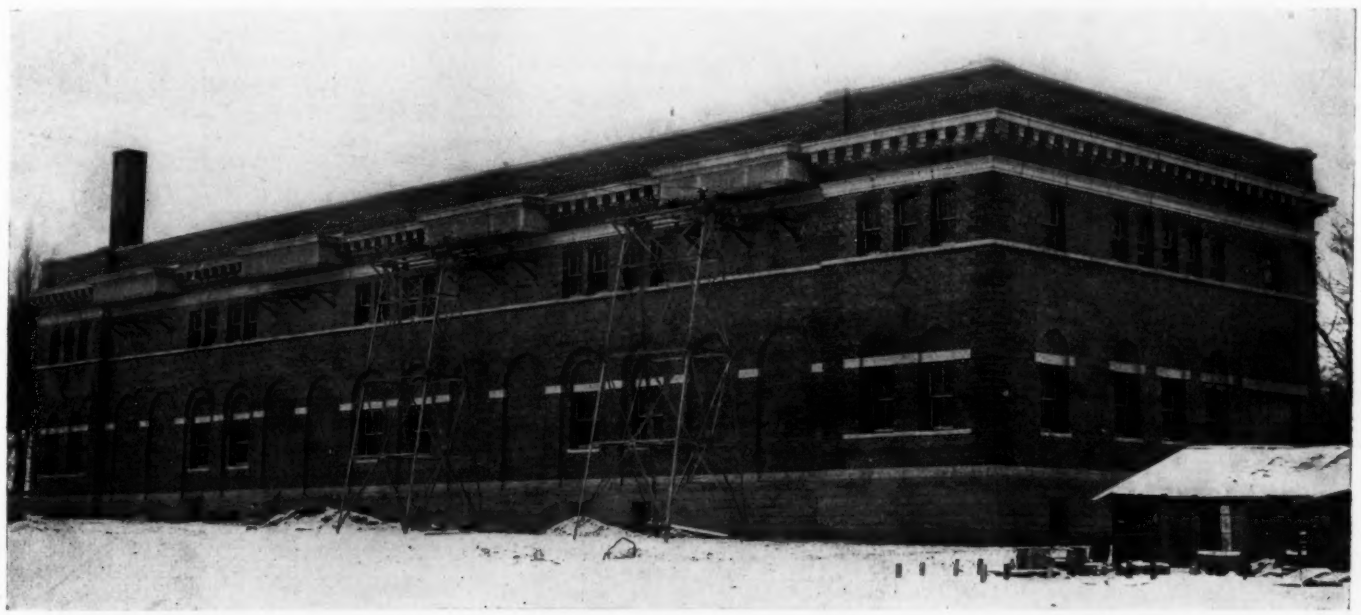


FIG. 1.—TORONTO TERMINAL STATION.

Switches designed to open a circuit carrying 7,200 kw at 60,000 volts are not seen frequently enough to be commonplace, and those at the Toronto sub-station deserve detailed notice. Each brick and stone compartment, in which the two oil cylinders carrying the terminals of one three-phase conductor are located, is 4.5 by 3 ft. in floor area and 7.75 ft. high, and the partitions of fire brick between the compartments are 8¼ in. thick. In front of each compartment there is an iron door hung at the top. Each compartment or cell contains two cylinders mounted vertically in a common frame, and an end of one conductor of a three-phase circuit enters the bottom of each cylinder. These two cylinders and the frame that carries them are made of wood, save as to four porcelain insulators that unite the legs of the frame with the part that holds the two cylinders together. Pine wood is apparently the material of which the many pieces that go to make up a cylinder are composed, and the outside is well served with shellac.

Heavy petroleum fills each of the wooden cylinders, and through a small central hole in its built-up cover plunges the vertical connecting rod that is electrically connected by a metallic cross

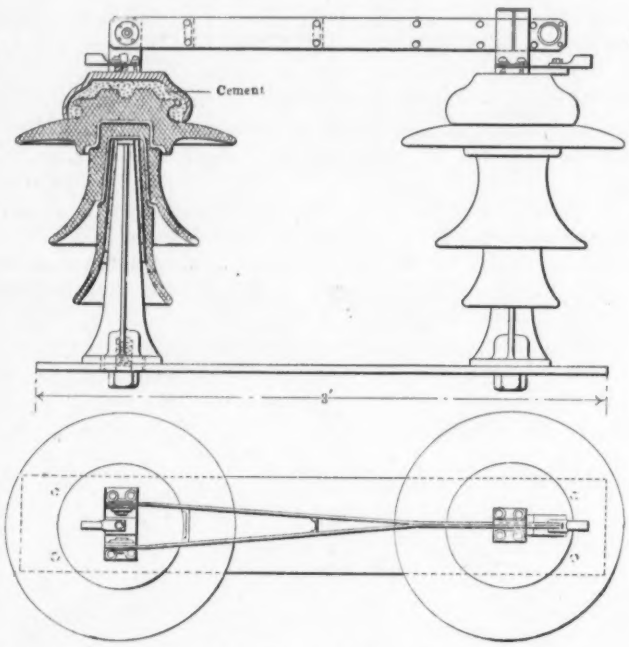



FIG. 2.—DISCONNECTING SWITCH FOR TORONTO TERMINAL STATION.

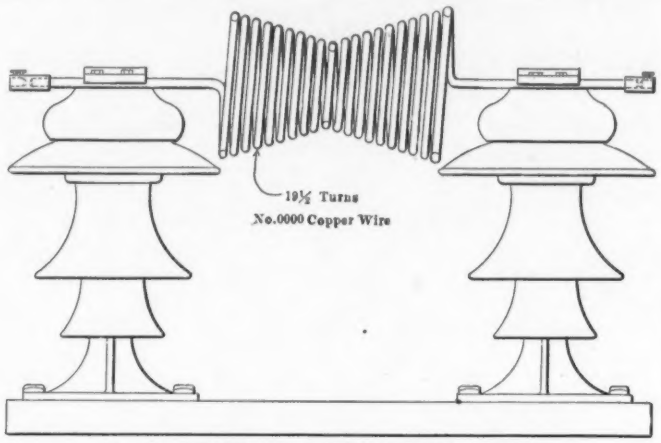
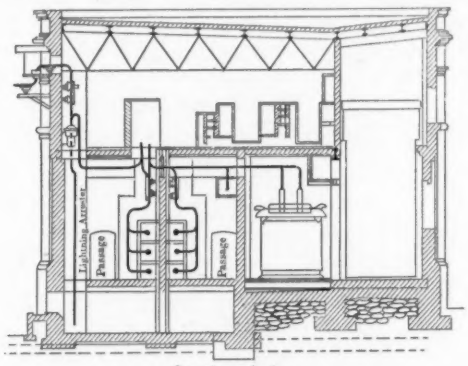



FIG. 3.—CHOKE COIL FOR LIGHTNING ARRESTER.




Section A-A

FIG. 4.—SECTIONAL VIEW OF TORONTO STATION.

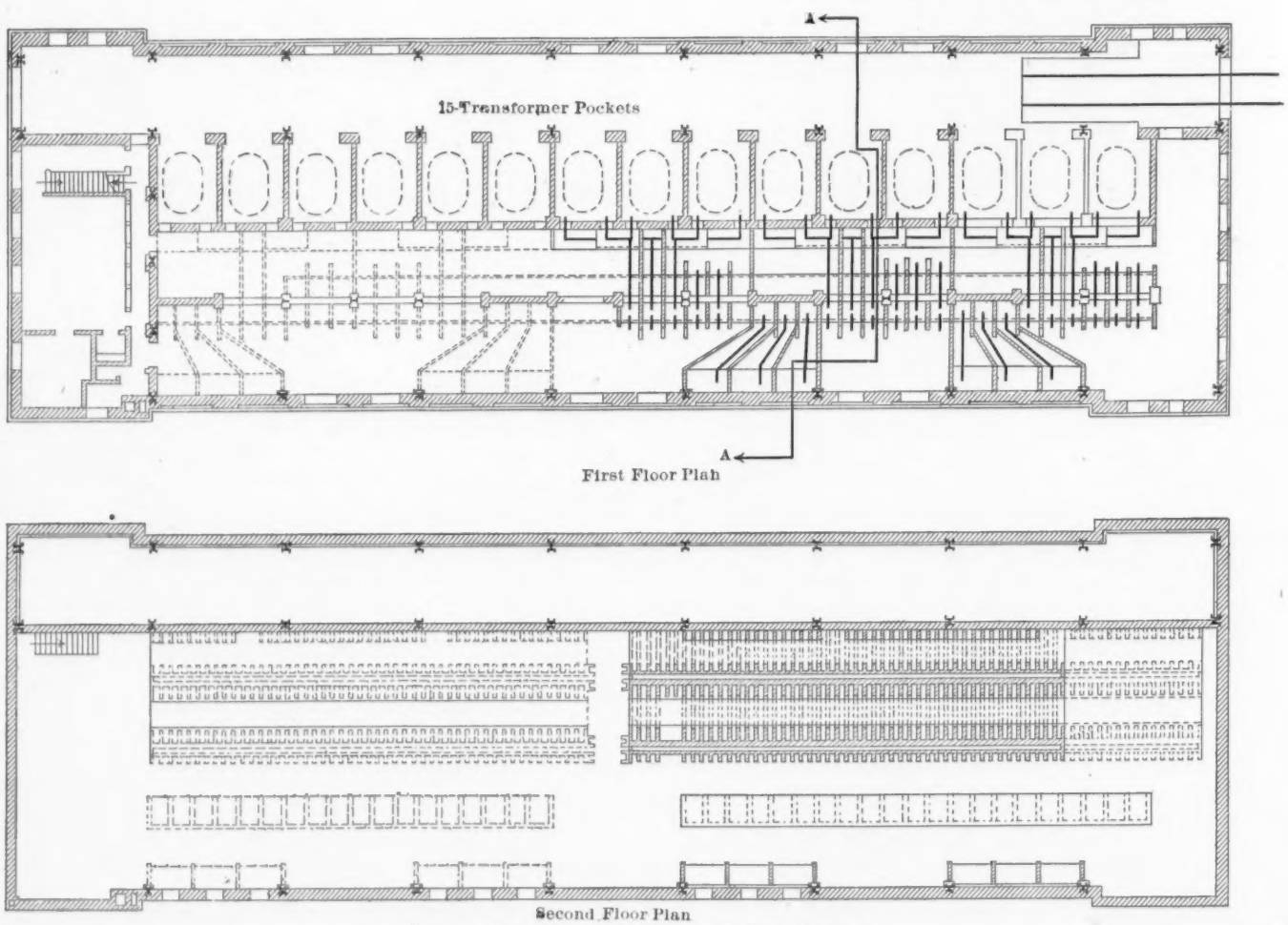



FIG. 5.—PLANS OF FIRST AND SECOND FLOORS.

THE LARGEST SUB-STATION IN THE WORLD.

piece with the corresponding rod of the twin cylinder. From this cross piece a vertical wooden rod rises through the stone top of each cell to the motor-driven operating mechanism above. In diameter each pine wood cylinder measures about 10 in., and its length is 32 in. It may be assumed that these wooden cylinders have been adopted in order to avoid the tendency of arcs to strike through the contained petroleum to the side of a metal cylinder, when the circuit is opened.

Each pair of connecting rods for a conductor of a three-phase circuit, in one of the 60,000-volt, 300-amp. oil switches, has a break or throw of 33 in., so that the conductor is opened by a total break of 66 in. From its oil switch each conductor of a 60,000-volt circuit passes to a connecting switch by which it is joined to a short, separate bus-bar, and this short bus-bar may be joined by other connecting switches either to another oil switch and then to the regular 60,000-volt bus-bars, or else to another oil switch and then to the primary coils of its transformer. By this combination of switches with the short and the regular 60,000-volt bus-bars, each conductor of a three-phase transmission circuit may be connected, through two oil switches in series, with the primary coils of its usual group of transformers, or through a series of two oil switches with the regular 60,000-volt bus-bars. Any group of three transformers may have its primary coils connected to the regular 60,000-volt bus-bars, through a series of two oil switches and one of the short bus-bars. The result is that any conductor of a 60,000-volt transmission circuit may be connected to either of the four groups of transformers, or all the circuits and transformers may operate in parallel.

Each of the 2,400-kw, 60,000 to 12,000-volt transformers is oil-insulated and water-cooled, and is located in a separate pocket, of which the walls are brick and the door steel. The fifteen pockets for as many transformers are ranged on the same level

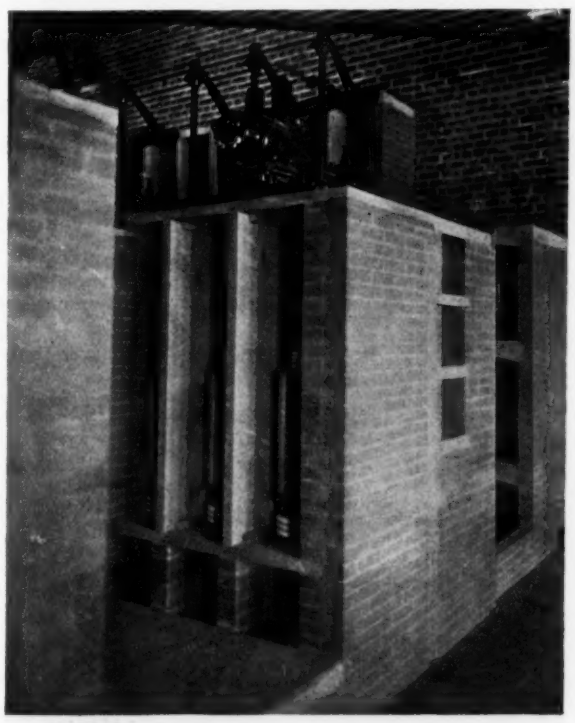


FIG. 6.—12,000-VOLT OIL SWITCHES.

in a single row and a track for the transformers runs into each pocket. Water pipes from these transformers run to inlet and discharge points and the pipes carrying oil connect with a system of storage and emergency tanks, filters and an air compressor and exhauster. All of the oil piping is of brass.

The 12,000-volt leads from the transformers go to either of two sets of three-phase bus-bars, by way of either of two sets of oil switches. Similar oil switches connect with the 12,000-volt bus-bars the underground cables that run to the several sub-stations about Toronto. There are 31 of these 12,000-volt, motor-operated oil switches for three-phase circuits, 25 of which are rated at 300 amp. and the remaining six at 500 amp. Each 12,000-volt oil switch is located in three brick and stone cells, similar to those above described. The break or throw of each contact rod in the oil cylinders is 20 in.

Both the 12,000-volt and the 60,000-volt bus-bars are carried in cells of brick and stone and in the case of the 12,000-volt

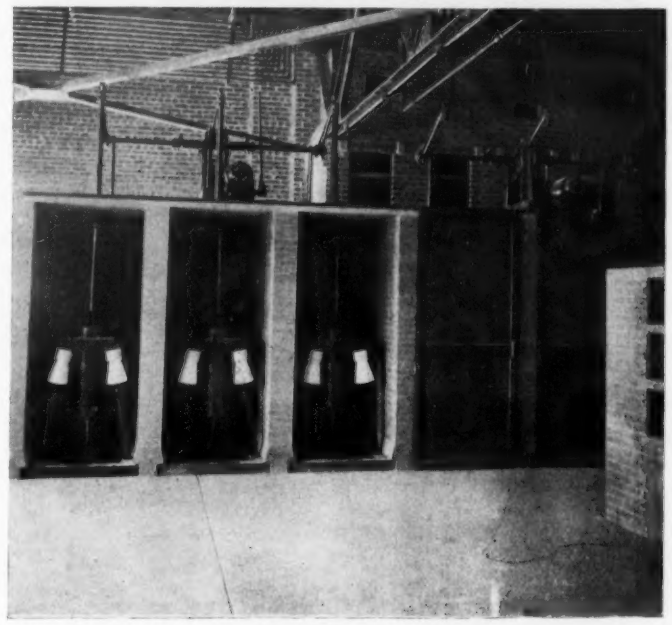


FIG. 7.—60,000-VOLT OIL SWITCHES.

bus-bars, their cells adjoin those of the corresponding oil switches. The 60,000-volt bus-bars are located some feet distant from their switches, however, and between the rows of cells that contain the two sets of these bus-bars there is a 13½-in. brick wall.

Construction of the cell type is provided for the other parts of the 12,000-volt and 60,000-volt circuits as well as for the bus-bars, and each conductor of a 60,000-volt circuit is carried in a separate compartment from the time it enters the terminal station until it reaches the transformer pocket. For each conductor of a 60,000-volt circuit the compartment is about three feet square, and its partitions are at least four inches thick and built of hard burned shale brick or of concrete.

All of the oil switches are controlled from operating boards located some distance away, but on the same floor. There are two of these operating boards, one controlling the 60,000-volt, and the other the 12,000-volt circuits. Leads from these controlling boards to the motors that operate the oil switches are run through iron conduit pipes laid in the floor. Besides the controlling switches and dummy bus-bars, the switchboards carry switch operating relays, power factor indicators, and wattmeters and watt-hour meters. The watt-hour meters are located behind the operating panels. A motor generator in connection with a storage battery supplies current at 125 volts, for the operation of the motors of the oil switches, and for lighting the sub-station. For the operation of other motors about the sub-station, a bank of three 15-kw transformers step down the 12,000-volt, three-phase, 60-cycle current to 110-220 volts. If the above motor-generator fails to operate, the battery is automatically connected to the lighting circuits.

Steel, brick, stone, tile and concrete are used in the construction of the terminal or sub-station on Davenport Road, just outside of the Toronto city limits, and substantially no wood is to be found in any of its parts. The building measures about 61 by 202 ft. on the ground, and its height includes two stories and a basement. Architecturally the sub-station is of pleasing design, with high ashlar underpinning, brick walls pierced by numerous windows, and stone trimmings.

The sub-station is located near the main line of a steam railway, and a spur track enters one end of the building at the

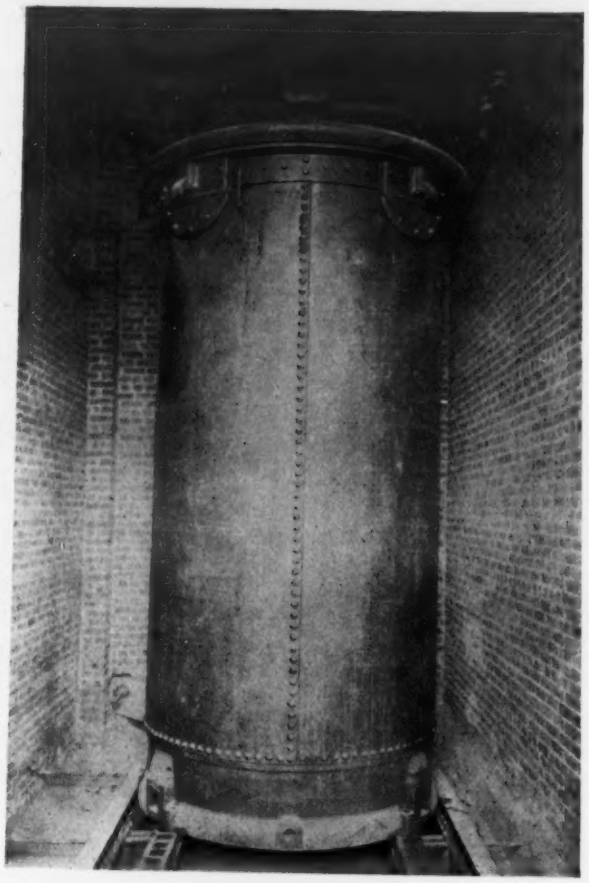


FIG. 8.—400-KW TRANSFORMER.

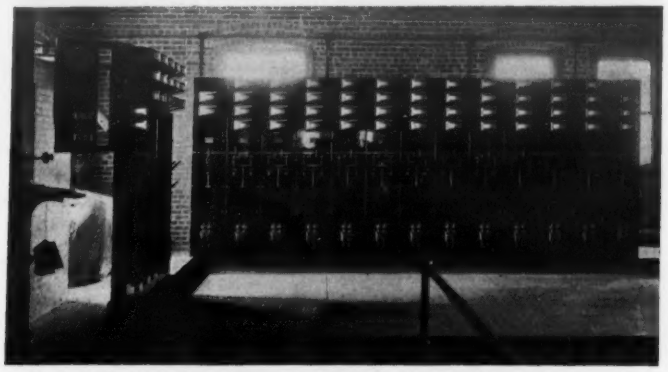


FIG. 9.—CONTROL SWITCHBOARD.

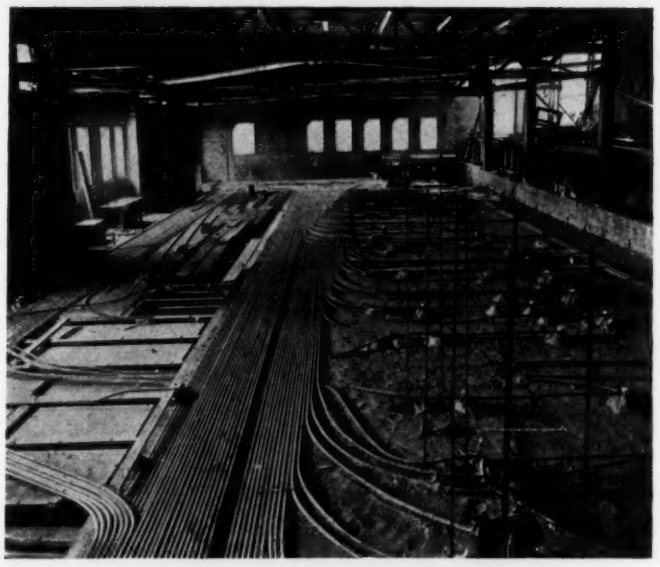


FIG. 10.—CONDUITS FOR CONTROL WIRES.

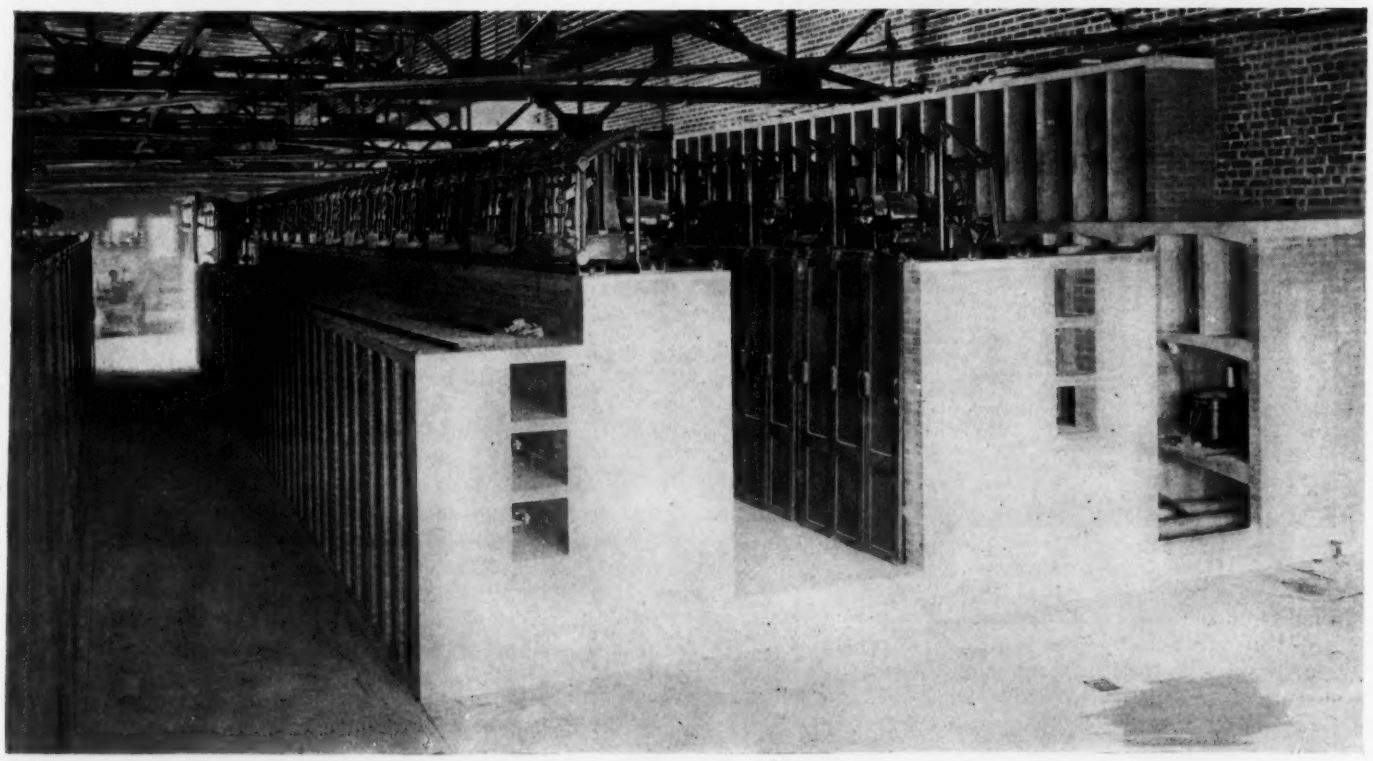


FIG. 11.—OIL SWITCHES AND BUS-BARS.

THE LARGEST SUB-STATION IN THE WORLD.

ground level, so that cars containing the transformers or other heavy apparatus may be unloaded directly on to the first floor. On the west side of the station, at an elevation of about 42 ft. above the ground, there are four entrance hoods for the four 60,000-volt, three-phase circuits from Niagara Falls. Each of these entrance hoods has three compartments, one for each conductor of its circuit, and is built up of concrete on a steel frame.

A terminal tower carrying one three-phase circuit sets close to each entrance hood, and before entering the underside of the hood each conductor is attached to a steel bracket that runs out from the station wall. In the interior of the terminal station, on its east side, a clear space about 12 ft. wide, and extending from the first floor to the roof, runs its entire length in front of the row of fifteen transformer pockets. Over this area moves a traveling crane for handling the transformers, and a brick wall separates the upper part of the space from the remainder of the second story of the station. Over this area in front of the transformer pockets the nearly flat tile roof is supported by I-beams, and the remainder of the roof is carried on steel trusses.

In addition to the two-story space in front of the transformer pockets, the first floor is taken up by these pockets, the bus-bar compartments and the lightning arrester passages, and the second-story contains the oil switches and the controlling boards, and also the upper parts of these same passages. On passing through the west wall of the sub-station, each conductor of a 60,000-volt circuit enters a vertical passage, enclosed by brick partitions, that leads to the basement. In the upper part of each of these passages are the connecting switches that lead respectively to the lightning arresters and to an oil switch. Just beneath these connecting switches is the current transformer, and then comes the long bank of lightning arresters.

After the 60,000-volt conductor passes below the level of the second floor, it turns into a horizontal passage and runs to a point directly beneath its oil switch. Between the first and second floor the space under the 60,000-volt oil switches is shut in by brick partitions, and is sub-divided by other partitions into separate passages for each conductor. Within this same space are the brick and stone compartments for one set of 60,000-volt, three-phase bus-bars, to which the conductors from the oil switches lead. These bus-bar compartments are built against a 13½-in. brick wall, and on the other side of this wall there is another set of 60,000-volt bus-bars and another space running from the first to the second floor, like that just described. On either side of the 13½-in. brick wall between these two vertical spaces there are connecting switches for each conductor.

As a result of the erection of the 60,000-volt circuits in the enclosed spaces and passages just mentioned, each conductor of these circuits is isolated from all others, and is completely surrounded with masonry, from the point where it enters the sub-station to the transformer pocket. In this way the isolation of the high-voltage conductors is, perhaps, more complete than has ever been attained before in a sub-station.

The row of transformer pockets is about 166 ft. long, and the enclosed space that contains the two sets of 60,000-volt bus-bars with their conductors and connecting switches is of equal length. Between the row of transformer pockets and the enclosed bus-bar space there is a foot passageway along the first floor, and a like passageway runs between the other side of this enclosed space and the vertical compartments where the lightning arresters are located. At intervals along the walls that enclose the lightning arrester and the bus-bar spaces there are hand holes and archways in the brickwork, so that the conductors and apparatus can be erected, and the connecting switches operated. On the second floor the oil switches are in three rows. Two of these rows are made up of the 12,000-volt switches with the 12,000-volt bus-bars in the same masonry structures, and the third row contains the 60,000-volt switches alone. Across and at one end of the second floor and in view of the oil switches are the control switchboards.

The basement extends under only about one-half of the sub-station, and this half is divided into two parts by a brick wall parallel with the row of transformer pockets. In that part of the basement that is nearer to the transformers, are located their oil and water pipes, and also the oil tanks. The other part of the basement contains the lower ends of the lightning arresters for the 60,000-volt circuits, and into this part of the basement come the 12,000-volt underground cables that connect the terminal sub-station with the several lighting and railway sub-stations in Toronto.

As described in former issues of the ELECTRICAL WORLD, there are two principal sub-stations in Toronto devoted to the general distribution of power for lamps and motors, and two main sub-stations for the street railway system. It is intended that these principal sub-stations and some minor ones, operating the entire electrical supply and traction systems of the city, shall distribute Niagara power to most of their loads.

The above terminal sub-station of the Toronto and Niagara Power Company has been erected and equipped under the direction of Mr. Robert C. Brown, chief electrical engineer of the company. Plans for the complete work were from the office of Dr. F. S. Pearson, consulting engineer.

The transformers, oil switches, and all of the above named electric equipment were made by the General Electric Co., or in some part by the Canadian General Electric Co.

## Measurement of Power in Three-Phase Systems.

BY E. RAY SHEPARD.

In high-voltage, three-phase systems where step-down transformers are employed for the wattmeters, it may occasionally be necessary to measure the power with only one transformer. One

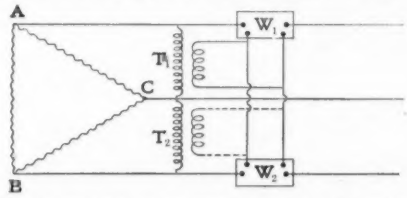



FIG. 1.—CONNECTIONS OF TRANSFORMERS AND WATTMETERS.

of the two may have been burned out or for some other reason only one may be available. This may be done by connecting the two wattmeters to the one transformer. In this case the power will no longer be the sum of the two readings, but it will be twice the reading of the normal one minus the reading of the other.

The dotted lines in Fig. 1 show the ordinary connections when two transformers are employed and in which case the sum of

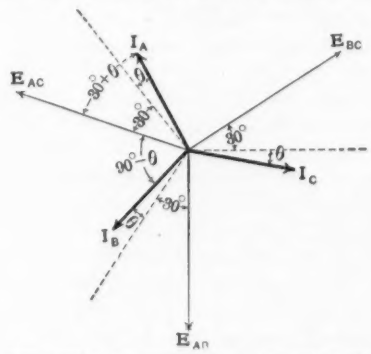



FIG. 2.—PHASE RELATION OF CURRENTS AND ELECTROMOTIVE FORCES.

the two wattmeter readings is the power of the system. The full lines show how $W_2$ may be connected to $T_1$, where $T_1$ is the only transformer employed.

Fig. 2 shows the relations of currents and pressures in the system, from which it is seen that the readings of the wattmeters will be:

$$W_1 = E_{AC} I_A \cos(30° + \theta), \text{ where } \theta = \text{the angle of lag;}$$

also $$W_2 = E_{AC} I_B \cos(90° - \theta). \text{ Expanding these we have}$$

$$W_1 = E_{AC} I_A \{\cos 30° \cos\theta - \sin 30° \sin\theta\}$$

$$= E_{AC} I_A \{\tfrac{1}{2}\sqrt{3}\cos\theta - \tfrac{1}{2}\sin\theta\}$$

$$= \tfrac{1}{2} E_{AC} I_A \sqrt{3} \cos\theta - \tfrac{1}{2} E_{AC} I_A \sin\theta$$

$$2W_1 = \sqrt{3} E_{AC} I_A \cos\theta - E_{AC} I_A \sin\theta$$

$$W_2 = E_{AC} I_B \{ \cos 90^\circ \cos\theta + \sin 90^\circ \sin\theta \}$$

$$= E_{AC} I_B \sin\theta;$$

and if the system be balanced,

$$2W_1 - W_2 = \sqrt{3} E I \cos\theta - E I \sin\theta + E I \sin\theta$$

$$= \sqrt{3} E I \cos\theta,$$ or power in a three-phase system.

Of course, this is true only for a balanced system and is of no help with a commercial polyphase watt-hour meter.

## Deflection Potentiometers.

By H. B. Brooks.

*U. S. Bureau of Standards.**

INSTRUMENTS for the measurement of electromotive force and current may be divided into two main classes, which may be called deflection instruments and balance instruments, respectively. Each of these two classes, as is well known, has its advantages and disadvantages. An ideal instrument would be one combining as much as possible of the convenience of the deflection instrument and the accuracy and constancy of the potentiometer or balance instrument. With the above requirements in mind, it occurred to the writer that a satisfactory instrument might be realized by using the potentiometer method to measure the bulk of the electrical quantity, in conjunction with a suitable deflection instrument to measure the small remainder, which may be of the order of one per cent of the total. For example, if an e.m.f. is between 110 and 111 volts, the potentiometer method may be used to measure 110 volts, the other part being read by the deflection instrument.

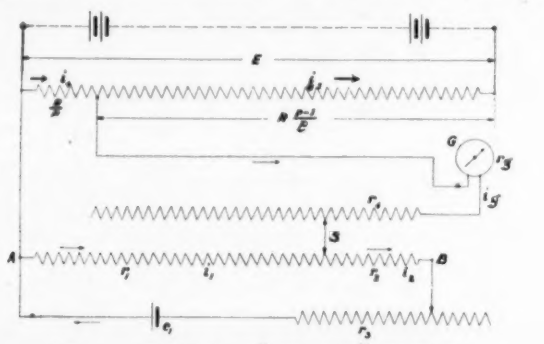


FIG. 1.—DIAGRAM OF "VOLT BOX" CIRCUITS.

The potentiometer is essentially a null instrument, and the function of the galvanometer ordinarily is to show, by the absence of a deflection, when the unknown e.m.f. is compensated by the known. In some cases, however, as in measuring low e.m.f's, it is desirable to read one more figure in addition to that given by the lowest dial; and in such a case, with some forms of potentiometer, it is possible to interpolate between adjacent settings on this dial. In the present case the problem is to determine the conditions to be met, first, in order that the deflection corresponding to a given unbalanced e.m.f. may always be the same, regardless of the setting of the potentiometer dials; and second, in order that the deflection should be strictly proportional to the unbalanced e.m.f. for a relatively large unbalancing, as it is ordinarily assumed to be for a small unbalancing.

Assuming that the instrument is to be used for measuring e.m.f's higher than those of a single cell, a "volt box" will be required, as shown in Fig. 1, in which $E$ is the unknown e.m.f. to be measured, $e_1$ that of the auxiliary storage cell, $R$ the total resistance of the volt box, the fall of potential around a fraction of this, $R/p$, being opposed to the fall of potential around a portion, $r_1$, of the potentiometer wire, $AB$. It was seen that to obtain the condition of constant sensibility a rheostat would be required in the galvanometer circuit, this rheostat being controlled by the motion of the main dial, represented by the slider, $S$. For simplicity the standard cell and connections for using it to check the working current in $AB$ are not shown, as they do not affect the problem. Assuming that the condition of balance does not exist, and denoting the currents and resistances in the various branches by $i_1, i_2 \ldots r_1, r_2 \ldots$, and applying Kirchoff's laws, the following equations are obtained:

$$i_1 - i_2 + i_g = 0 \qquad (1)$$

$$i_4 - i_5 - i_g = 0 \qquad (2)$$

$$i_1 r_1 + i_2 (r_2 + r_3) = e_1 \qquad (3)$$

$$i_1 r_1 - i_g (r_4 + r_g) - i_4 \frac{R}{p} = 0 \qquad (4)$$

$$i_5 R \frac{p-1}{p} + i_4 \frac{R}{p} = E \qquad (5)$$

Solving these equations,

$$i_g = \frac{e_1 \left( \dfrac{r_1}{r_1 + r_2 + r_3} \right) - \dfrac{E}{p}}{r_4 + r_g + \dfrac{r_1 (r_2 + r_3)}{r_1 + (r_2 + r_3)} + R \dfrac{p-1}{p^2}} \qquad (6)$$

The first term in the numerator of this expression is the fall of potential in the portion $r_1$ of the potentiometer wire when the galvanometer circuit is open; it is therefore numerically equal to the setting of the potentiometer. The second term in the numerator is the fall of potential which would exist around the portion $R/p$ of the volt-box if the galvanometer circuit were open. The denominator is the total resistance in the galvanometer circuit, the third term being the resultant resistance of the portion $r_1$ of the potentiometer wire shunted by the remainder of the battery circuit, and the fourth term the resistance of the portion $R/p$ in parallel with the remainder of the volt-box. Equation (6) therefore shows that the current through the galvanometer is equal to the unbalanced portion of the e.m.f. divided by the total resistance of the galvanometer circuit; or

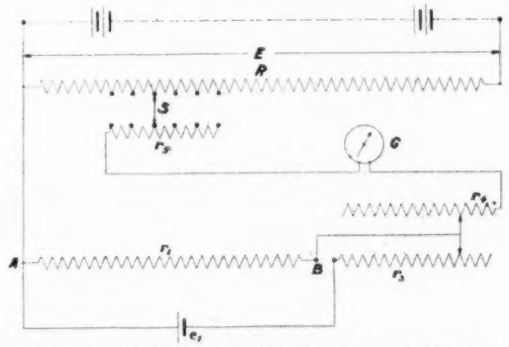


FIG. 2.—ANOTHER ARRANGEMENT OF CIRCUITS.

$$i_g = \frac{\Delta e}{\Sigma r}. \qquad (7)$$

Referring to equation (6) the first term in the numerator, which may be called the setting, may be denoted by $s$. Since the volt-box has a multiplying power of $p$, the equation may be written in the form

$$i_g = \frac{ps - E}{p \Sigma r} \qquad (8)$$

which shows that if $\Sigma r$ can be kept constant the galvanometer current will be directly proportional to $(ps - E)$, the difference between the e.m.f. corresponding to the setting and the e.m.f. to be measured. If $\Sigma r$ can be kept constant for all settings, it is only necessary to calibrate the scale of the galvanometer properly to make it read directly the unbalanced part of the e.m.f. under measurement. Referring to Fig. 1 and equation (6) it will be seen that the resistance, $r_4$, must have such values for different positions of the slider, $S$, that the sum of $r_4$ and $\dfrac{r_1 (r_2 + r_3)}{r_1 + (r_2 + r_3)}$ will be a constant. The latter has a maximum value at some point between $A$ and $B$, and minimum values at $A$ and $B$; so that $r_4$ must vary accordingly.

* Abstract of a more detailed paper to be published in a forthcoming number of the *Bulletin* of the Bureau.

A difficulty in the way of using this particular arrangement of circuits lies in the fact that the value of $e_1$ depends on the condition of the storage cell, and as $e_1$ varies $r_3$ must be varied to keep the proper current through $AB$. This difficulty may be overcome by using the circuits shown in Fig. 2.

In this arrangement the setting is made on the volt-box instead of on the potentiometer wire. The rheostat, $r_3$, is set so as to give, by reference to a standard cell (not shown) a certain standard current through $AB$ and therefore a constant fall of potential around it. This fall of potential is balanced as nearly as possible by setting the slider, $S$. The variable resistance, $r_4$,

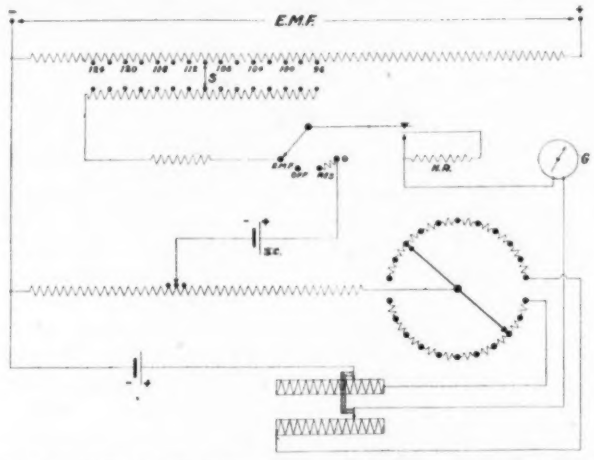



FIG. 3.—DIAGRAM OF CIRCUITS OF DEFLECTION POTENTIOMETER.

is arranged so that $r_4$ plus the resultant resistance of the potentiometer circuit is a constant; $r_4$ thus takes care of changes in resistance required by variations in the e.m.f. of the auxiliary cell, but is independent of the setting. The fraction $\frac{1}{p}$ being in this case a variable, the resistance in the galvanometer circuit must vary with it, as may be seen from equation (8). Since in this second arrangement the e.m.f. term, $e_1 \frac{r_1}{r_1 + r_3}$ is a constant, it may be denoted by $e$. Therefore,

$$i_g = \frac{1}{p} \cdot \frac{pe - E}{\Sigma r}. \qquad (9)$$

For a difference of one volt between the setting $pe$ and the e.m.f. $E$ under measurement the galvanometer is to give a deflection of

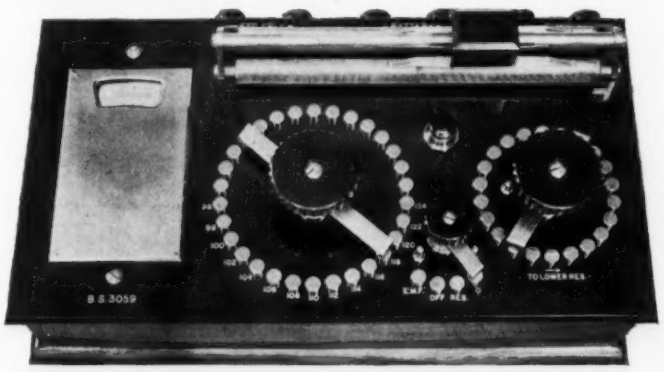



FIG. 4.—VIEW OF DEFLECTION POTENTIOMETER.

$m$ scale deflections. If $I$ denote the current required to give a deflection of one scale division, the current $mI$ must always flow when $pe - E = 1$. Substituting these values,

$$mI = \frac{1}{p} \cdot \frac{1}{\Sigma r} \qquad (10)$$

$$\Sigma r = \frac{1}{p\,m\,I} \qquad (11)$$

Equation (10) shows that the compensating resistance, $r_3$, in the galvanometer circuit, which is controlled by the movement of the slider, $S$, must vary so as to keep the product $p\Sigma r$ a constant. Equation (11) holds for the first arrangement also, shown in Fig. 1; in this case, $p$ being a constant, $\Sigma r$ must be constant and equal to $\frac{1}{p\,m\,I}$.

The galvanometer to be used as a part of this instrument should be of the needle type, preferably one that is pivoted and does not require an arrestment. It should have a good zero, a short period and a calibrated scale. For laboratory use a reflecting galvanometer of short period may be used, but in many applications, as in checking switchboard instruments in position, the use of such a galvanometer would be a serious drawback.

A deflection potentiometer has recently been constructed in the instrument shop of the Bureau in accordance with the foregoing principles, and has been put into service for voltage measurements in photometric work. The range of this instrument is from 95 to 125 volts. Fig. 3 gives a diagrammatic plan of the circuits in the instrument. The main dial has fifteen steps, each of two volts, the galvanometer normally covering a range of two volts, although it may be used over a range of three volts; that is, one and a half volts on each side of the setting. To avoid errors in the photometric work the resistance, $R$, was made high, being 50,000 ohms. The resistance in the battery circuit is 2,000 ohms total when the e.m.f. of the storage cell is 2 volts. On account of these high resistances the galvanometer sensibility required is greater than would ordinarily be necessary. The galvanometer gives 1 mm. deflection for 1.6 microamperes. The internal resistance is 270 ohms and the period on open circuit 1.3 seconds. When in use, with its circuit closed through the potentiometer, the motion of the needle is very nearly aperiodic, and readings may be quickly made. The battery current is regulated by a rheostat of ten steps, in connection with a slide rheostat for

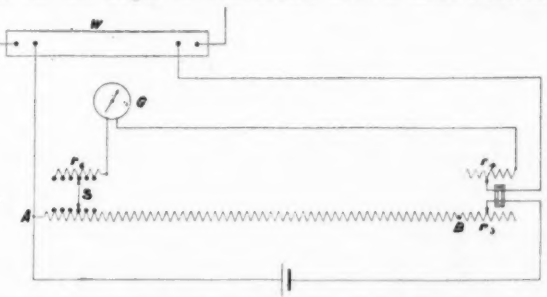



FIG. 5.—DIAGRAM OF CIRCUITS OF MILLIVOLTMETER.

fine adjustment. The e.m.f. of the storage cell may have any value between 1.9 and 2.1 volts.

A view of this deflection potentiometer is given in Fig. 4, from which it is seen that the galvanometer is built into the apparatus so that it is self contained with the exception of the standard cell and storage cell.

It is interesting to note that while the plan of circuits shown in Fig. 1 is not convenient for use in measuring voltages higher than those of a single cell, it is the most suitable one to use in a deflection potentiometer for measuring currents. Any standard current shunt may be used, and it need not be an integral part of the potentiometer proper, which thus constitutes a precision millivoltmeter. The circuits for an instrument of this kind are shown in Fig. 5. A current shunt, $W$, replaces the portion $R/p$ of the volt-box in Fig. 1, and only a limited portion of the potentiometer wire, $AB$, is used, corresponding to the drop in the shunt at full load, say 150 millivolts. Since only a small portion of the wire, $AB$, is used, the compensating resistance, $r_4$, may correct for the small changes in the resultant resistance as the battery rheostat, $r_3$, is altered, for the position of $S$ corresponding to full load through the shunt. The compensation for smaller loads will not be theoretically exact, but the error may be made negligibly small. In an instrument for this purpose it is an advantage to use a smaller resistance in $AB$, in order to reduce the necessary sensibility of the galvanometer and to keep within limits the source of error just referred to. By proper design a high grade of portable galvanometer like the one before mentioned, if suitably wound, will be sensitive enough, and will be of advantage when the instrument is to be used, say, for checking ammeters in position on switchboards, and for use in laboratories when it is desired to have a portable precision ammeter which is independent of external disturbing forces.

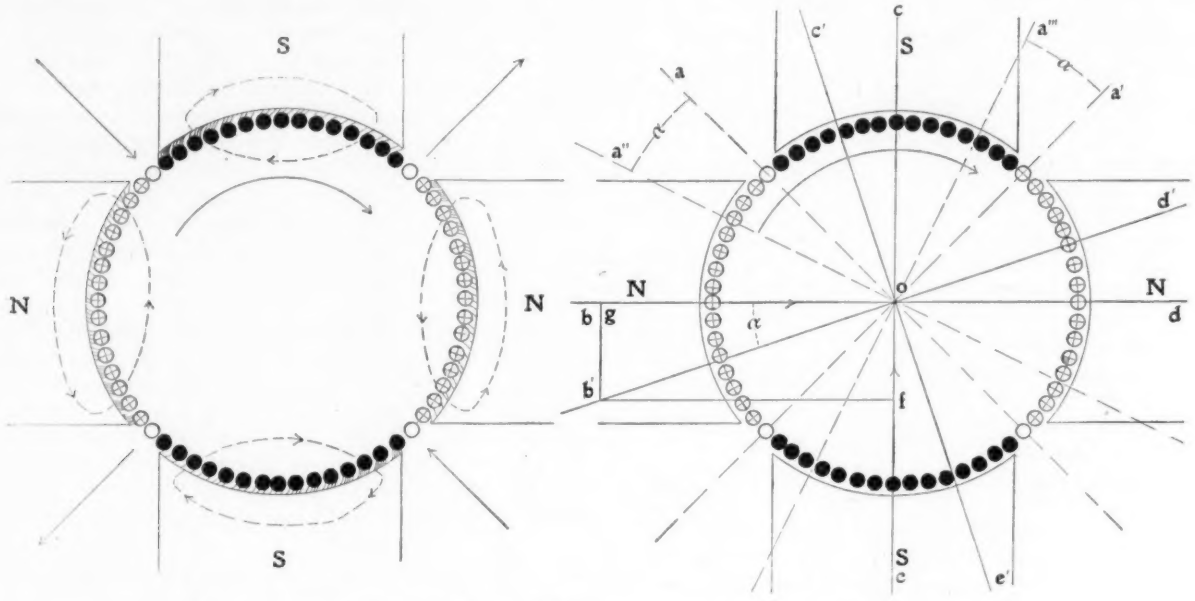
# A Graphic Method of Showing the Action of Auxiliary-Pole Variable-Speed Motors.

By Norman G. Meade.

In Fig. 1, *N, S, N, S* are the four poles of an ordinary multipolar motor. The light and dark circles about the periphery of the armature represent the conductors. In the dark circles the current is supposed to be flowing away from the observer, and in the light circles toward the observer. Under these conditions, with the armature revolving in the direction of the curved arrow, the magnetic flux set up by the armature conductors travels in the paths shown by the dotted lines, producing the well known phenomenon of weakening the leading pole tips and shifting the neutral point.

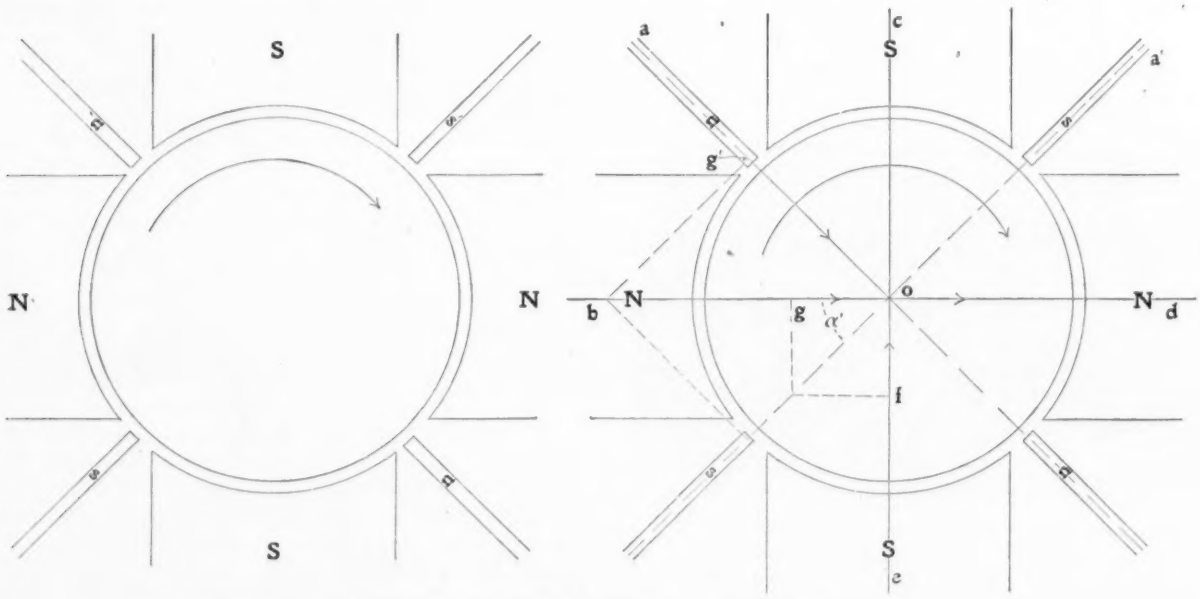
In Fig. 2 this is shown in a somewhat different manner. The dotted lines, *a* and *a'*, represent neutral lines without armature current. From *b* and *d* to the origin, *O*, thence to *c* and *e*, illustrates graphically the path of the field flux. To show the effect of armature reaction, let *f-o* represent the flux set up by the cross-ampereturns of the armature, which acts at an angle with the field flux represented by *g-o*. Now, considering these two factors as forces, they resolve themselves into a parallelogram, and the diagonal, *b'-d'*, and the line at right angles, *c'-e'*, give the new path of the field flux, it having been shifted through the angle, *α*, by the effects of the armature reaction, causing the no-load neutral lines, *a* and *a'*, to shift through an equal angle to the positions *a"* and *a'''*.

As the factor *g-o* varies with the change of speed by field weakening and the factor, *f-o*, with the load, the position of the neutral point is dependent on the magnitude of both factors and the position for sparkless commutation varies accordingly.




Figs. 1 and 2.—Diagrammatic Representation of Armature Currents.

The addition of auxiliary poles, as shown in Fig. 3, introduces a new element, the effect of which is graphically illustrated in Fig. 4 in an exaggerated manner. In the example given it is assumed that the motor is operating at one of its higher speeds; consequently the field is considerably weakened by the introduction of resistance which reduces the factor *g-o*, shifting *b-d* and *c-e* to positions parallel with the theoretically neutral lines, *a* and *a'*. Let *g'-O* represent the auxiliary pole factor acting on the first diagonal at *O*; then the diagonal of the second parallelogram will be *b-d*, restoring the neutral points to their normal position.




Figs. 3 and 4.—Diagram Showing Addition of Auxiliary Poles.

# The Effect of Acid Frosting and Enclosing Globes Upon the Life of Incandescent Electric Lamps.

BY J. R. CRAVATH AND V. R. LANSINGH.

THE last few years there has rightly been a tendency in incandescent lighting to lower the intensity of the source of light, either by using enclosed diffusing globes or else by frosting the lamp bulb itself. The diffusion obtained by these methods has not only resulted in more artistic effects, but has also made the light much easier on the eyes, and has undoubtedly aided in popularizing the use of the incandescent lamp. In this connection, the question has arisen as to the relative efficiency of the two available methods, which are:

1. Frosting the lamps themselves and using them without enclosing globes.

2. The use of the bare lamp with a diffusing enclosing globe either ground glass, opal, Holophane or other types.

It has generally been conceded that a frosted lamp, as far as efficiency is concerned, is more economical than a plain lamp with a diffusing globe. Generally speaking, the absorption by such frosting is in the neighborhood of 10 per cent, while with the use of ground glass, and other types of diffusing globes, the absorption runs from 12 per cent to 25 per cent or more. The question as to the effect on the life of the lamp has, as far as the authors know, never been satisfactorily answered to date.

The authors, in previous articles in this paper, have advocated the use of some sort of cover or gasket for the neck of an enclosing globe, such a cover being formed of asbestos, mica or some similar material which will keep out all dust and, in the case of white asbestos, increase the light below the horizontal. In order to determine the effect on the life of the lamp, with these various conditions, tests were made on the following at the Electrical Testing Laboratories:

1. Frosted lamp, bare.
2. Clear lamp and diffusing globe.
3. Clear lamp, diffusing globe and asbestos cover.

Thirty lamps were selected from among a large number which were purchased direct from the manufacturer. They were of 16-cp, 115-volt, 3.1 watts per candle, oval anchored filament type. These lamps were selected with a view to securing those free from perceptible defects. When received they were divided into three groups. In making this division the only consideration was the efficiency; an endeavor being made to have the same average candle power and watts consumed for each of the different groups. One of the three groups was then taken to the factory of the manufacturer and was there frosted by the usual acid process. The ten lamps after frosting were again photometered in order to determine the absorption and modification of the distribution of light, due to the frosting.

The enclosing globes used were of the "Holophane" type, being spheres, 6½ in. in diameter with 3¼-in. holders. Ten of these were used without any cover while ten others were protected with an asbestos disk or washer which practically prevented any dust from entering and at the same time had a tendency to throw down any light striking the white surface. This type of globe was selected for the reason that while the glass is heavier than the ordinary type of globe, the increased radiating surface, owing to its numerous prisms, would tend to increase the radiation.

The first tests made were to determine the absorption and modification of the distribution of light, due to the three methods given above. As will be seen from the data given later, the loss of light due to the frosting of the lamp itself was 9 per cent, while the loss due to the absorption of the globe was about 16½ per cent. The distribution of light, as thus obtained with the above combination, is shown in Fig. 1, where the photometric curve of the bare lamp is also given for the sake of comparison.

The effect of frosting a lamp is to decrease the candle power at all angles, with the exception of that directly underneath and directly above the lamp.

The type of globe used in this test is known as one which aims to diffuse the light in all directions below the horizontal rather than redirect it in any one direction. This is shown by Fig. 1. It will be noticed that the use of an asbestos disk slightly increases the useful light at all angles below the horizontal. Other things being equal, it would seem desirable to use asbestos disks with any form of enclosing globe, thereby preventing the accumulation of dust on the inside and increasing the useful illumination at the same time. In this connection it should be noted that the use of such a disk or washer prevents the dust from settling on the lamp itself as well as on the inside of the globe. The importance of keeping the inside of the globe, and the lamp itself perfectly clean has been well brought out in tests reported on by Messrs. Legg and Townsend at the Chicago Public Library, where in the case of clear lamps and porcelain reflectors, the average increase of light, due simply to wiping off the lamps and shades with a cloth, was nearly 30 per cent.

After the absorption test was finished the three groups of lamps were placed on life test. All were burned pendant upon the same racks and under the same conditions; a frosted lamp, a lamp in a Holophane globe, and a lamp in a diffusing globe with asbestos disk being placed in turn. All were operated on a 60-cycle, constant-potential, alternating-current system, in which the average pressure fluctuations did not exceed ¼ of 1 per cent above or below normal. The lamps were burned un-

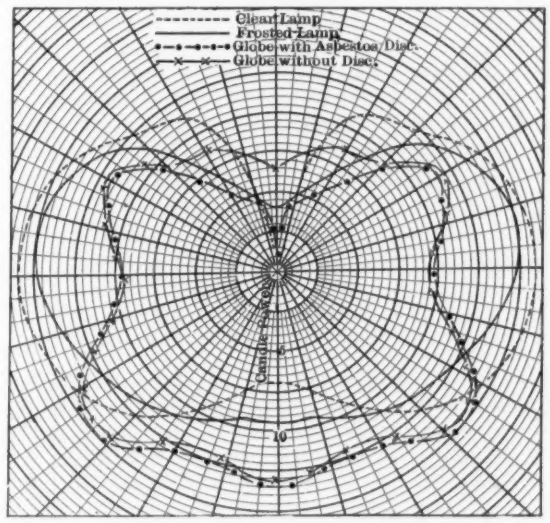



FIG. 1.—CURVES OF LIGHT DISTRIBUTION.

der such conditions throughout their useful lives. Neither the frosted lamps nor the globes were cleaned in any way.

After the test had been in progress 144 hours and 336 hours respectively, the mean spherical candle power of each of the ten frosted lamps was determined. After the test of the lamps burned within the globes had been in progress 288 and 516 hours respectively, their mean spherical candle power values when used with the globes was determined. At more frequent intervals, the mean horizontal candle power of the lamps was deter-

| | Group No. 1 Frosted. | Group No. 2 in globes. | Group No. 3 in globes and disks. |
|---|---|---|---|
| Initial m. s. c. p. as modified | 12.2 | 11.1 | 11.1 |
| Watts per initial m. s. c. p. | 4.15 | 4.55 | 4.55 |
| Per cent. loss of light as compared to clear lamps | 9.0 | 16.5 | 16.5 |
| Mean zonular c.p. | | | |
| Lower 45 deg. zone | 10.6 | 12.9 | 13.4 |
| Lower 60 deg. zone | 11.3 | 13.4 | 13.9 |
| Lower 75 deg. zone | 11.8 | 13.2 | 13.5 |
| Lower hemisphere | 12.4 | 12.4 | 12.6 |

mined in order to establish the rate of deterioration in candle power.

Because of the nature of the light units tested the only practicable method of comparison is on the basis of mean spherical candle power. All candle power results shown in this report, are, therefore, reduced to this basis. The lamps were burned in

every case to 80 per cent of their initial mean spherical candle power.

The net results of the tests made at the beginning are given in the following table:

LIFE TESTS OF LAMPS.

| | Group No. 1 Frosted. | Group No. 2 in globes. | Group No. 3 in globes and disks. |
|---|---|---|---|
| Average life to 80 per cent of initial c.p. | 216 hours | 428 hours | 423 hours |
| Corresponding candle-hours | 2383 " | 4401 " | 4384 " |

In studying the results we note that the loss of light, due to the frosting of the lamp is 9 per cent, while in the case of the type of globe used in this test the loss was 16½ per cent. When, however, the question of life is considered, we find that the life with a frosted lamp is only 216 hours, whereas the globe under test gives 428 hours or nearly twice the life. If we multiply the average mean spherical candle-power by the number of hours of useful life, we find, in the first case, we have 2,383 candle hours, while in the second place we have 4,401 candle hours; an increase of 85 per cent. Fig. 2 shows the life hours and the candle-power graphically. Care should be taken not to confuse this with horizontal candle hours commonly used in considering the life of incandescent lamps.

Coming now to the question of asbestos disks in the neck of enclosing globes, we find that the total flux of light is practically the same in either case, but that the light in the lower hemisphere is increased about 2 per cent, and that the loss of life, due to the same, is only about 1 per cent. Inasmuch as there is a great gain due to the fact that dust is prevented from falling on the inside of the globe, and also on the lamp itself, it is beyond question a desirable thing to equip all pendant enclosing globes with some form of cover to prevent the collection of dust or dirt. Dirt collecting in the bottom of a diffusing globe is not only a cause of loss of light, but is inartistic and slovenly. It shows much more plainly in a diffusing globe than in any other and should be avoided both on account of the efficiency and appearance.

The object of frosting lamps is to cut down the intense glare

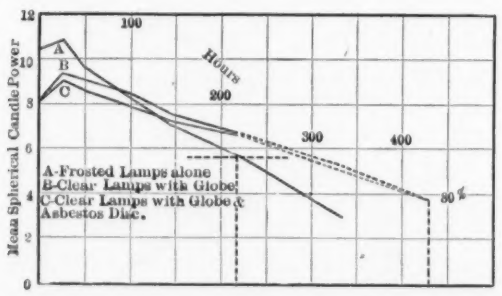



FIG. 2.—CURVES OF AVERAGE CANDLE-POWER PERFORMANCE.

of the bare filament with the least possible loss of light, rendering the lamp more agreeable to the eye and giving a more artistic effect. In many instances, the same results can be obtained by the use of ground glass diffusing globes with a corresponding increase in the life of the lamp. Where a reflector is needed and at the same time diffusion of the light from the lamp filament is advisable, a frosted bulb lamp is still the most easily available device for securing diffusion. It is to be regretted that the tests did not include ground glass as well as diffusing globes, but judging from the tests given in previous articles in these columns by the authors on the absorption by ground glass globes, it is probable that a test on these would show very nearly the same results as here obtained.

The usual guaranteed life of bare lamps of this kind with clear glass bulbs is 450 hours. The loss of life by enclosing them in globes is, therefore, about 5.5 per cent, while the loss of life by frosting is about 52 per cent.

# Consolidation of Electric Power Stations in Switzerland.

By W. Weissenbach-Griffin.

Up to the date of this writing there is only one instance of the consolidation of several independent central station companies, namely, two power stations, built in 1899 and 1900 and situated in Canton Berne, were united. The Kander station is located in the Berne highlands and the Hageneck station near Biel and their transmission lines meet near the city of Berne, one coming from the south and one from the west. The Kander station has a maximum capacity of 6,000 turbine horse-power under a head of 223 ft. and producing a normal power of 4,000 kw.

The Hageneck station has a maximum capacity of 4,000-5,000 turbine horse-power, under a head of from 23 to 32 ft., and giving a total power of 4,000 kw. The two stations together serve a population of 140,000 people contained in 40 or 50 towns, the longest transmission being about 37 miles. The polyphase transmission lines are operated at 4,000 volts and 16,000 volts respectively, while the distribution voltage is 2 × 125 volts for lighting, and for power 250 volts and 3,000 volts. The Kander station also supplies a standard gauge railway between Thun and Burgdorf with 1,500 kilowatts polyphase power.

The consolidation of these stations was made possible by the co-operation of the canton Berne—the Cantonal Bank took two-thirds of the stock. It remains to be seen whether the combination will result in an increase in the dividends or not. Both companies paid well before combining.

The general consolidation of electrical generating stations in Switzerland will become a necessity with time. At present there are 196 stations with the following capacities:

| | | |
|---|---|---|
| 11 | stations | 50,000 kw |
| 21 | " | 30,000 " |
| 164 | " | 31,000 " |
| 196 | " | 111,000 " |

There are too many small stations. There is a lack of uniformity in the rates charged for power and light, as will be seen from the following:

Sixteen candle-power incandescent lamps burning 1,700 hours per year from 128 to 952 francs ($25.60—$190).

Sixteen candle-power incandescent lamps burning 500 hours pay from 550—2,616 francs ($110—$520) per year.

Three horse-power motors working 3,000 hours pay from 135—420 francs ($27—$84) per horse-power-year.

Fifty horse-power motors pay from 110—325 francs ($22—$65) per horse-power-year.

This non-uniformity will, in many cases, be the stumbling block to a readjustment of rates, especially where the arrangement does not result in an increase. Here it is interesting to note that some of the small stations show very good results, and by buying cheap power transmitted from a distance the building of the extension of existing plants is rendered unnecessary.

One of the hindrances to the consolidation of plants is the difficulty with the operating personnel of the small plants. This difficulty is sure to occur and have an influence upon the results. As a rule, small Swiss plants can be operated at a very low cost.

Among the Swiss cities with from 20,000 to 165,000 inhabitants, a dozen have municipal lighting plants, some of which buy power from stations situated at a distance, while others purchase from local companies to help out.

In Berne, Zurich, St. Gall, etc., the power is transmitted from a distance and added to that produced by the municipal plants, the original city plants, which were driven by steam engines or water turbines, not being large enough to take care of the growing business. Then a larger municipal plant was obtained nearby and finally power was taken from a private station which was built in the meantime. The purchase of power from private companies is often only a temporary arrangement to tide over to the time when the city will be in a position to build or assist

in building an hydraulic station, or buy outright a station which has been built by a private company. The consolidation of municipal plants becomes more important as the cities acquire more central stations.

A new epoch for such mergers will follow as soon as large hydro-electric stations are built for the operation of the Swiss Bundesbahnen (United Railways). It will be good policy for these stations to sell electrical energy in connection with their regular load in order better to utilize the water power and give a cheaper power for traction. These new stations will do away with many of the small stations in their districts. In most cases it will prove advantageous to consolidate plants which are scattered along the banks of the same stream, and which utilize the water power for electric transmission and industrial purposes. By combining the plants and building one large central station, which will utilize the greatest head and be equipped with large and efficient machinery, a much more economical result will be obtained than was possible with the small stations.

From the above the situation in Switzerland can be stated as follows: Although many plants will best please their local customers as well as the owners, by working out their own development, there is an opportunity for both large and small plants, in building new stations for mixed loads, to reach out and supply current to many communities, which hitherto have had unsatisfactory service, due to high rates, poor service, bad regulation or faultily designed distribution system.

In the cities the electrical supply service, including central stations for lamp, motor and railway loads, is not a private but a municipal undertaking. The state has a few electric stations built as cantonal plants, but since the railroads belong to the Bund (Union), the state will build hydro-electric plants to supply power for traction. The general service to the public is supplied by private corporations and these will continue to exist so that there will be three sources of supply in the field at the same time; private plants, state plants, and the city plants, which fact should aid in promoting consolidation.

Laws which deal with water power concessions are now being drafted and will be laid before the next parliament. These laws concern the delivery of power outside the country as well as the construction of the plants. Complications due to canton borders and the non-uniformity of the cantonal laws, will be removed so that new plants can be built without infringing the right or sovereignty of the cantons over water powers.

## Electrical Terminology.

BY T. M. ROBERTS.

The following suggestions are offered, not to increase an already large vocabulary of electrical terms, but rather to do away with not a little confusion often present with the use of the words *alive* and *loaded* as applied to conductors. These two terms may be supplemented by a third term, or else a more careful distinction made in the use of them. The evidence is in favor of a third term, for the present ones, as often loosely used, do not convey to the average mind the true state of things electrical, as regards safety and danger.

For illustration: The three accompanying figures have been submitted to three prominent electrical engineers, A, B and C; and their use of the terms *dead, alive* and *loaded* are here given.

In the first case, they all agree that a conductor having zero voltage and no current traversing it is *dead.*

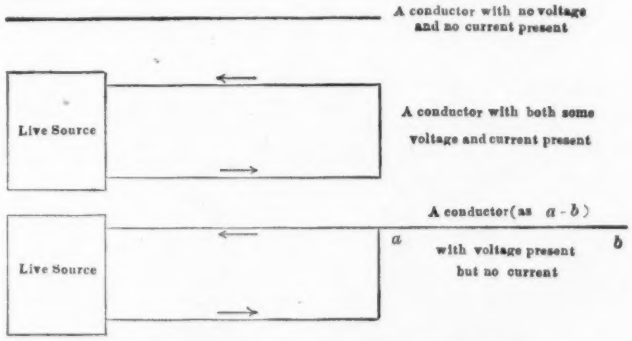
To the second case, they all apply the term *alive,* yet engineer A says it is *alive* and *loaded.*

In the third case A says the conductor is *alive* and *unloaded,* which is a nice distinction. B says the third conductor is *loaded* as distinguished from the second, which is *alive.* And C says both the second and third conductors are *alive,* and that the two terms *dead* and *alive* cover all three cases,. and no third term is needed.

Several other terms have been loosely applied to both the second and third conditions, yet the above is sufficient to establish the fact that a *dangerous looseness* of the application of electrical terms is in common use; dangerous because, even to a technical person, an ambiguous term is misleading, and because the uninformed are deceived, which frequently leads to disaster. For who has not seen, or heard of someone receiving a shock—perhaps fatal—from some conductor that was supposed to be dead, but which proved to be *alive* in the *unloaded* sense of Engineer A—that is, having potential but no current. An experienced electrician knows and appreciates the difference between the second and third conditions, but to the inexperienced person, a conductor that carries no current is dead, and can be touched with impunity. It is the ambiguous terms and the use of misleading phrases that often give trouble.

The term *load* and its derivatives *loaded* and *unloaded* are already overloaded with several different meanings. And granting the desirability of the use of synonyms in giving flexibility to our language, does not the third condition deserve a third specific term? A thing is inherently what it is, irrespective of the name given it; and in matters where both public and private welfare as well as property are concerned, the term used to designate a thing should denote what the thing itself connotes.

An old Latin professor used to say to his students that when they were at a loss for a word to express the meaning of the context, "Call it *Tecumseh* and go on." But now when electrical science is spoken of as an exact science, it is both humiliating and confusing to be hampered with ambiguous terms. And even if such terms are in common use (words that need additional words to explain their meaning), it must be said in deference to the progressive spirit of electrical engineers, that they are, pre-eminently, inventive pioneers to adapt practical means to practical ends. And when the means are suggested, the general public is every ready to follow and glad to adopt a


A conductor with no voltage and no current present
Live Source
A conductor with both some voltage and current present
A conductor (as a - b)
a
b
Live Source
with voltage present but no current

FIGS. 1, 2 AND 3.—ELECTRICAL TERMINOLOGY.

single, definite term for a particular thing, and not a clumsy, cumbersome, "Tecumseh" expression that says one thing and means another.

A term for the third case, which is readily self-suggestive, is the word *asleep.* I am not aware that this word has ever been used by others in this meaning, yet its kinship to the terms *dead* and *alive* is sufficiently close to give it a place in everyday use. It denotes a state of a conductor whose condition connotes electrical inactivity; that is, not alive in the active or loaded sense, but alive in the inactive or unloaded sense.

Briefly, then, the three terms *dead, alive* and *asleep* would be used thus:

A conductor having no voltage and carrying no current is *dead.*

A conductor bearing both voltage and current is *alive.*

A conductor having some voltage above or below the earth, or surrounding conductors, but carrying no current is *asleep.*

As regards safety and danger, a *sleeping* wire is just as unsafe to touch as a *live* wire, for it is connected to and is part of a live circuit.

As regard fire risk, it is beyond dispute that idle conductors, whether they are *dead* or *asleep,* may be a source of trouble. For it is a very easy step to resurrect a dead wire into a sleeping condition and then just a touch of another potential is sufficient to create the *cause* of fire or accident which it is desirable to eliminate.

If a thing of importance has no name, it goes without saying that it needs a definite tag. And if it creates confusion and

trouble by being dubbed with appellations of doubtful import, a corrective effort should be applied to do away with whatever is objectionable. And this corrective effort is largely assisted by the adoption of a specific third term.

## Central Station Work at Beloit, Wis.

Beloit, Wis. (population, 10,000), has a combined water power and steam plant, operated by the Beloit Electric Company. The manager of the company, Mr. John S. Allen, is one of those who believes there are great opportunities for increasing central station business, and considers the solicitor to be the most important man a central station company has. The general methods used by this company are similar to those used at Madison where a business-getting organization has been at work for a number of years. As a result of the new business campaign, the company's net earnings have been doubled in the past two years. A solicitor has been employed for a year, who devoted all of his time to following up clews and inquiries brought in by advertising. The first three months the solicitor worked, business adding $1,000 per year to the company's gross income was taken on.

The company is a liberal advertiser in the Beloit daily papers. Most of the advertising so far has been concentrated for the purpose of increasing the use of electric light for sign and display purposes among the stores in the down-town district.

### RATES FOR SIGN LIGHTING.

Contracts for sign and decorative lighting are taken at flat rates and the lights turned off at midnight by the company's patrolman. These rates are calculated to be equal to what the customer would have to pay if he were purchasing current on the Doherty system of charging in vogue in Beloit and described later, plus $12 per year to cover the cost of a patrolman's services. These rates are as follows:

| | | |
|---|---|---|
| 2-cp lamp | $2.40 | per year |
| 4-cp " | 3.20 | " " |
| 8-cp " | 4.50 | " " |
| 16-cp " | 9.00 | " " |
| 3 glower Nernst | 41.33 | " " |
| 6 glower Nernst | 94.66 | " " |

### WORDING OF ADVERTISEMENTS.

The advertising, as stated before, has been mainly directed towards securing more sign and display lighting, although some relate to power. In all this advertising, the idea is impressed on the merchant that an electrical display is to be looked upon as an advertisement and a method of getting business rather than as simply a lighting expense. One expression of which considerable use is made is: "A bunch of bright bulbs will boom your business better than a brass band." Another advertisement has a border around the headlines consisting of a number of plain black lines arranged in what appeared at first to be a rather haphazard manner. Within this border is a single line in boldfaced type: "Electric light talks." Underneath was the following: "These black lines represent the outline of a prominent building in the city. Guess what and where it is. No need to tell you about the enterprising firm that has foresight enough to see that their lights *stand out* and talk for their business." Another advertisement read: "An electric sign is not costly; its unattractive neighbor is the expensive sign." Another advertisement is worded as follows: "What makes a business center? Business. What draws business? Lots of light. You and your neighbors can be in the city if you want to be. Get together. We will furnish the light and the light will furnish the business." Another attempt to get the attention of the merchant was worded about as follows: "This man is a stranger in town. He wants to buy some shirts, collars and a few cigars, etc. He doesn't go up one side of the street and down another looking for a good store. The electric sign shows him where to go. It tells him which store is the most progressive and that he will find there a better choice of goods, more courteous clerks and a more congenial proprietor." Among the longer advertisements was the following: "The first 10 per cent of your gross business doesn't show much profit. The last 10 per cent should be all profit. With your present equipment and your knowledge of business it would be very easy to increase those profits enormously by spending a small amount of money on electrical display. Let us tell you about the small cost and big returns." Of course, all advertisements are signed Beloit Electric Company. Among the shorter advertisements and expressions used the following have been selected: "Get the habit of studying your windows. Is your store front as attractive as it might be?" "Electric light talks (for your business)." "Tonic for business depression. More light."

The company has no special place reserved for its advertisement in the paper and the matter of location is left to the newspaper itself. The space used is also varied. One advertisement last winter was headed: "How to keep frost from show windows," after which followed an article on the use of a fan motor for keeping the warm air in circulation against the inside of a show window so as to keep the merchant from losing the value of his window display in very cold weather. The company at one time sent out a little booklet published by the Westinghouse Electric & Manufacturing Company instructing the consumer to read his own meter. At the same time a short article appeared in the newspapers on this subject. In connection with advertising and securing power business a copy of the following advertisement is of interest as showing the importance of being prepared to take advantage of opportunities. The advertisement was as follows:

"Man kept his temper. Motor helped him out. Last night at 11 o'clock a steam engine broke down at the Beloit steam laundry. Bad time for a breakdown. We got a message to put in a motor. This morning the laundry is running same as ever. The proprietors kind of like the way we use them. They like the motor even better and the chances are good that Mr. Steam Engine hits the rubbish heap. Just a start, a trial, in electric motor use and you tie up to it right away. Send us the word now. Don't wait for a breakdown. You simply can't depend on steam. Beloit Electric Company."

### FIGURES ON A REFRIGERATING OUTFIT.

The company has at present but one motor driving an artificial refrigerating plant, but this is a very interesting installation because of the fact that figures are available on its cost of operation as compared to the previous cost of ice. The plant is in the store of Rouse & Bibbins, a progressive meat market. The motor is of 7½ hp and is belted to a countershaft from which a meat chopper can also be driven. The ice box or cold storage room is 16 x 27 ft. The ice machine is a Larsen, made at Omaha, Neb., and costing about $1,400. Brine tanks are used for storage so that the refrigerating machine need not be operated continuously. The motor, which is of the three-phase induction type, cost about $300. The cost of the cold storage room motor and refrigerating machine complete was about $2,500. The bills for the operation of this motor, which of course also includes its operation for running the meat chopper, were as follows from April to December, 1905: April, $22.86; May, $23.22; June, $27.33; July, $33.62; August, $37.80; September, $32.24; October, $25.92; November, $19.59; December, $17.93. The average per day for 275 days is 87 cents.

The storage room formerly used in this meat market was kept cool by ice and had dimensions 8 x 18 ft., giving a floor area of 144 sq. ft., as against 432 for the new room. The owners state that this former storage room took about $2 worth of ice per day. In other words, it cost over twice as much to cool a room of one-third the capacity of the present room. This leaves a large margin in favor of the electric refrigerating outfit over and above the interest on the investment. As to maintenance and depreciation, this item is very low for the mechanical refrigeration and high for the ice box, as an ice box rots out in the course of a few years and has to be entirely rebuilt. Mechanical refrigeration produces a dry cold and has the further advantage that it is always on hand when wanted regardless of whether the ice dealers are overworked or not.

ELECTRIC HEATING.

The company put about 50 flatirons out on trial in August and got very few back. Of course this was rather late in the season to begin a flatiron campaign. These were all 6-lb. household irons. The company has about six tailors' irons in use on its lines, these irons weighing from 12 to 18 pounds. An overall factory in the town is also trying electric irons. Warming pads have been very successful, there being about three dozen of these out in the town. A novel application of electric heating has been made at the farm of F. W. Morgan, located about 2½ miles from Beloit. An American Electric Heater Company warming plate is used in an incubator and is found an ideal method of keeping a uniform heat. On this farm there is a 20-hp Wagner single-phase motor which is mounted on a wagon and used around the farm for various purposes where power is required. There is also a motor used for blowing a pipe organ at this house and numerous other applications of electricity.

NERNST LAMPS.

The company has about 50 Nernst lamps on its circuits. The three-glower size is the most popular. The cost of materials for glower renewals for 1905 was about 5 cents per glower per month. Some of these lamps are in saloons where they are run all night and others are in stores which close at 6 o'clock except two nights per week and on factory pay day nights, which come two nights per month. These Nernst lamps are inspected once a week by the men who trim commercial arc lamps.

RATES.

The company has two systems of charging, one of which is a readiness to serve or Doherty system. Under the Doherty contract the consumer agrees to pay the company a service charge of $1 per month, plus 10 cents per 16-cp lamp connected or its equivalent, plus 10 cent meter rent, plus a meter rate of 5 cents per kw-hour. From the total bill 25 per cent is deducted for payment on or before the tenth of the month following. The Beloit Electric Company agrees to test without charge any consumer's meter to determine its accuracy upon the request of such consumer, provided not more than two tests a year are requested. Additional tests will be made only at the expense of the consumer unless the meter should prove to be wrong and against the consumer. No additional lights or apparatus using current are to be connected to wires which are in at the time the meter was set, without first notifying the central station; otherwise the consumer will be held responsible for any damage done the meter.

As the Doherty contract is not attractive to some customers, they are given the option of the following contract: A minimum bill of $1.10 per month plus 15 cents per kw-hour for the first 25 kw-hours consumed, plus 12 cents per kw-hour for the second 25 kw-hours consumed, plus 9 cents per kw-hour for all over that. As a matter of fact, the rates on the contract are 18 cents and 15 cents for the first 50 hours, a discount of 3 cents per kw-hour being allowed for payment before the tenth of the following month.

The system of distribution is 2,300-volt, 60-cycle, three-phase primaries with 110-220-volt, three-wire, single-phase secondaries for lighting. Power and lighting are operated off the same primary feeders.

The company has about 500 hp in motors connected, the equivalent of 16,000 16-cp lamps and 64 10-amp. open series street arcs. It is hoped to do away with the latter in the near future. Inside wiring is turned over to a concern which is friendly to the company.

## New Telephone Patents.

PUSH-BUTTON MESSAGE COUNTER.

A manually-operated message counter adapted for location at the subscriber's premises, is the subject of a patent granted to Messrs. F. McBerty and E. B. Craft and assigned by them to the Western Electric Company. This apparatus is controlled jointly by a push button and by the operator. When a subscriber desires to call, he must push his button to signal the exchange. This act sets a switch so that it closes immediately upon the release of the button and not before. As soon as the button is released and the switch is closed it is impossible to offset the switch further without the assistance of the operator. When the switch finally closes it becomes locked by a catch under control of the armature of a polarized relay. This armature may be tilted either way according to the polarity of the impressed current. For a good call the operator works the armature to count one call and release. For a lost call a reverse current releases without affecting the counting mechanism.

LOCK-OUT SYSTEM.

Ralph Sherer, of Eaton, Ohio, has patented a lock-out party line system. This system while fairly simple in construction and operation, does not seem to be worked out upon a basis such as to meet the demands of practice.

## Recent Electrochemical Developments.

ELECTROMETALLURGY OF IRON AND STEEL.

Of all applications of the electric furnace, none has attracted more attention during the past year than its use in the metallurgy of iron and steel. While the dreams of some would-be inventors in the past were concerned with the big problem of reducing iron from ores in the electric furnace, the more practical engineers who are distinguishing themselves in the present industrial development early recognized that to make a success they had to set in at the weakest spot of the present art—that is, at the manufacture of high-class steels by the crucible method with its extraordinary expense.

In copper metallurgy all the first steps of the treatment of the ore up to the state where the product is already almost pure metallic copper, are purely metallurgical, and all attempts to reduce copper by electrochemical means directly from the ores—for instance, by using anodes made from copper ores—have been commercially unsuccessful. It is only at the last stage of the chain of metallurgical operations—for removing the last impurities—that electrolysis has proven the great success. Copper refinish has indeed proven so very successful in every respect that the capacity of the large refineries of this country is now double what it was six years ago.

By analogy we may conclude that electric furnace treatment will obtain prominence in iron and steel metallurgy for the refining of steel. The crucible process is by necessity very expensive, while electric furnace treatment promises not only to yield as good a product as the crucible process, but to yield it at a lower cost, mainly due to the reduced working costs.

In this respect a recent patent of P. L. T. Heroult is significant. The patent of Heroult to which we refer is a combination patent which is very broad in some of its claims. One of its claims covers the process of converting cast iron "or the like" into high-grade or crucible steel, by first treating the metal in a Bessemer converter and then transferring it to an electric furnace where it is finally treated to deoxidize and decarburize it. Since the metal is here received in fluid condition no electric power is required to melt it, and the power cost, which is often a most troublesome factor in the cost sheet of electrochemical processes, is comparatively small.

A second patent recently granted to Heroult is interesting on account of the huge scheme which it involves. The object is to provide a steel mixer of considerable capacity, in order to secure uniformity in the product of an entire works, to secure a certain desulphuration and decarburation and to conserve the oxidizable additions—such as silicon, manganese and the like—in order to reduce their quantities to a minimum. Dr. Heroult thinks of an electric steel mixer of a capacity of 300 or 400 tons to be fed by five or six Bessemer converters or open-hearth furnaces. Heat produced by the electric current has the advantage that it is non-oxidizing, while Heroult moreover provides a reducing atmosphere by the introduction of producer gas under pressure.

In the meanwhile reports have been published to the effect that the experiments carried out by Heroult with the assistance of the Canadian Government at Sault Ste. Marie, have been

quite successful, according to a telegram of Dr. Haanel, superintendent of mines, to the Minister of the Interior in Ottawa. It should be emphasized here that these experiments relate not to steel manufacture, but to iron reduction from the ores—for which the prospects of using electric furnace methods are far less favorable. Two points in Dr. Haanel's telegram are interesting. It is stated that the results are better than given in Harbord's report. This was, of course, to be expected, and it should be remembered that according to Harbord's report, with electric energy at $10 per electric horse-power-year and coke at $7 per ton, the cost of production in the electric furnace is approximately the same as the cost of producing pig iron in a modern blast furnace. It is evident that the results must turn out very much better than that, if the electric furnace is to become a commercial competitor of the blast furnace under general conditions.

Of course, local conditions may be more favorable to the electric furnace, and in this respect a second point in Dr. Haanel's telegram is interesting. Mention is made there of the production of nickel pig. This would sell well and represents, of course, an opportunity with a nickeliferous ores available at Sault Ste. Marie. To judge accurately what has been accomplished the full report of Dr. Haanel should be awaited.

In the meanwhile the chief application of the electric furnace in iron and steel metallurgy continues to be for the production of ferro-alloys. Imports from Europe have been very large in recent years, especially in ferro-silicon. Here the power is the most important item of cost and in some European plants, originally intended for the manufacture of calcium carbide, water power is available at a very low cost. At the same time strong efforts are now being made to extend the commercial manufacture of ferro-alloys in this country at suitably located points.

In the pioneer American ferro-alloy plant—that of the Willson Aluminum Company—considerable experimental work is being done. An indication is a recent patent of F. von Kuegelgen and G. O. Seward. The object is to produce ferro-alloys low in carbon—which is the principal technical problem of the whole manufacture. If the charge of carbon for reduction is made small, the expensive carbon electrodes will be rapidly consumed. The inventors, therefore, conduct the process with a view of prolonging the life of the carbon electrodes. Under these conditions the ferro-alloy produced is rich in carbon. In order to remove the carbon the same inventors formerly proposed to apply metallic calcium. In the present patent they suggest another method; they cast the alloy in form of pencils and employ two such pencils in an electric refining furnace in which the carbon is eliminated by the decarburizing action of the slag or lining. A suitable slag for refining ferro-chrome is a mixture of lime and chrome ore with suitable fluxes.

In this connection attention may be called here to the increasing interest in metallic calcium, since its chief use will probably be in the steel industry. Two patents for producing metallic calcium by electrolysis have recently been issued. The one granted to O. Ruff and W. Plato recommends the addition of calcium fluoride to calcium chloride as electrolyte in order to lower the melting point of the chloride. A mixture having a melting point of 650° C. is used, while the melting point of metallic calcium is 780° C. The inventors carry out the electrolysis at 760° C., and separate the two electrodes by means of a partition.

A second calcium patent was granted to W. Borchers and L. Stochem, who electrolyze fused calcium chloride with a comparatively small artificially cooled cathode against a large anode. Under these conditions calcium is obtained in the shape of a soft sponge upon the cathode.

### BATTERY INVENTION.

After several months had passed without a single battery patent having appeared—which was a most unusual phenomenon—the issue of patents of this class has recently again started. Details of construction of primary batteries have been patented by C. Jaeger, K. Tsukamoto, E. C. Henn and C. E. Lockwood and G. A. Lutz. The latter two inventors mix the depolarizer with a binder and enclose it in perforated retainers, like in the Edison cell. But when the depolarizer has been used up, they do not regenerate it by charging, but the old retainer is replaced by a new one with fresh depolarizer. The arrangement seems to be specially intended for cupric oxide as depolarizer in an alkaline cell, sugar being used as binder.

Details of storage battery construction are patented by W. Fennell and Wm. P. Perry and by D. P. Perry. An interesting patent referring to storage battery operation is that recently granted to L. Lyndon and assigned to the General Storage Battery Company. Its object is to make the operation of the end cell switch automatic. The end cell charging switch automatically sets the contact brush of the switch upon such a cell contact that all the cells on one side of the contact are fully charged while those on the other side are not. The device which actuates the switch is of an electrical nature and is controlled by one or more of the end cells.

## LETTER TO THE EDITORS.

### Compensating for Phase Differences.

*To the Editors of Electrical World:*

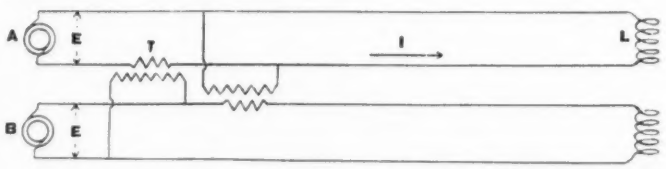
Sirs:—The accompanying diagram represents a suggestion as to a means of bringing the power factor back to unity in inductive, polyphase circuits.

$A$ and $B$ are the separate circuits of a two-phase generator, each working on an equivalent inductive circuit.

Let $E$ = voltage at generator terminals.
$L$ = inductance of load in henries.
$I$ = the current in each phase.
$\omega = 2\pi f$; in which $f$ = frequency.

Then the reactive e.m.f. of the inductive load will be equal to $\omega L I$.

$T$ is a booster type of transformer having either a fixed ratio, $\frac{E}{\omega L I}$, or a variable and adjustable ratio. The secondary or series coil is to be so connected in that its e.m.f. is in opposite phase to the reactive e.m.f. of the inductive load. A similar transformer arrangement is provided to neutralize the inductive reaction in phase $B$. Under these conditions the generator e.m.f's and the currents should be practically in phase. There will of




ARRANGEMENT OF BALANCING TRANSFORMERS.

course be a small current circulating through the primary or high-potential coil of each balancing transformer, and this current will be at right angles to the load current, but its magnitude should be too small to sensibly affect the phase of the current passing through the generator.

It is obvious that a similar pair of transformers could be applied directly at the inductive load, and in this case the pair shown in the diagram would only be required to correct the inductive reaction of the line alone.

Finally, as a three-phase system may be transformed into a two-phase system by well-known means, and the above correction applied, it is seen that the scheme is applicable to all commercial polyphase systems. It would also be possible to arrange transformers to produce a small corrective e.m.f. at right angles to the current in any wire of a three-phase system without transforming such system into the two-phase arrangement.

The advantages to be derived from the above method of unifying the power factor will be found in the increased generator capacity, and improved regulation, offset to some extent by the cost of transformers, which, however, will be of small capacity compared with the output of the circuits to be regulated by them.

Lincoln, Neb. George H. Morse.

[The scheme proposed by Mr. Morse possesses one vital defect. The current circulating through the high-potential coil of the

balancing transformer is not "small." In fact, it possesses a value such that when combined with the current flowing through the inductive load circuit the resultant current is out of phase with the generator voltage by exactly the same angle which would have existed if the balancing transformers had not been used.—EDS.]

# DIGEST OF CURRENT ELECTRICAL LITERATURE

## Dynamos, Motors and Transformers.

*Capacity of Transformers.*—DINA.—An account of experiments with a 80-kw, 100,000-volt oil transformer. Some of the results obtained were quite peculiar, but may be easily explained if it is considered that a transformer in operation has not only a magnetic field but also an electric field. In the latter they are not only closed electric lines of force, but also open lines of force, which therefore have two terminals which are the seats of quantities of electricity. A change of these quantities is accompanied by a charging current. It is, therefore, possible to speak of the electrostatic capacity of the transformer. Some effects of this capacity are the more peculiar the higher the secondary voltage of the transformer. In the secondary winding of the transformer when not connected to an external circuit, a charging current is flowing which changes from element to element of this winding. In the same transformer the distribution and the mean value of this current depends on the connections of the high-tension circuits. On account of the reaction of the secondary charging current upon the primary circuit, the intensity of the primary current and its phase difference with the primary voltage may have very different values. The primary current may also consist only of a watt component. The distribution of potential in the secondary winding is not always represented by a straight line, but may approximate a sinusoidal form. It is, therefore, possible that in the interior of the transformer higher tensions exist than the tension at the terminals. The ratio of the secondary to the primary voltage may be different from the ratio of the windings. Under certain conditions this ratio becomes much larger than the normal value, since the increase of the secondary voltage is then only limited by the losses (case of resonance). Especially with transformers for very high voltages and high frequencies these phenomena must be taken into account.—*Elek. Zeit.*, February 22.

*Single-Phase Commutator Motors.*—NIETHAMMER.—At starting the commutation is bad in all types of single-phase commutator motors. Since sparking during the starting period is due to a transformer e.m.f., there is theoretically a possibility of compensating it by a transformer e.m.f. which may be assumed to be produced by a double auxiliary pole. This represents, however, practical difficulties. The author discusses this remedy theoretically and shows that the use of a double auxiliary pole is necessarily connected with a number of essential disadvantages.—*Elek. u. Masch.*, February 18.

## Lamps and Lighting.

*Incandescent Lamps.*—GASTER.—In a paper on progress in electric lighting the author gave the following table of the variations in candle-power and consumption of standard 3.1-watt lamps due to changes in voltage.

| Percent of normal voltage. | Percent of normal c.p. | Consumption in watts per candle. |
|---|---|---|
| 90 | 53 | 4.68 |
| 95 | 74 | 3.76 |
| 99 | 94½ | 3.22 |
| 100 | 100 | 3.1 |
| 101 | 106 | 2.99 |
| 105 | 131½ | 2.62 |

The extent to which the useful life (i. e., a life lasting until the candle-power has fallen by 20 per cent) of a 3.1-watt lamp is shortened by overrunning is shown by the following figures:

| Percent of normal voltage. | Life factor. |
|---|---|
| 100 | 1,000 |
| 101 | .880 |
| 102 | .681 |
| 103 | .662 |
| 104 | .452 |
| 105 | .374 |
| 106 | .310 |

A lamp of fairly high efficiency will give the best results, but it must be run on a constant voltage. He recommends free lamp renewals, or failing that, the supply of lamps by the station at less than cost. Also he would have station engineers make freer use of portable voltmeters over their networks. In the light of the information thus obtained the voltage of the actual supply to customers ought to be arranged to suit the lamps or the lamps to suit the voltage.—Lond. *Elec. Times*, February 15.

*Mercury Vapor Lamps.*—An article discussing several new arrangements for starting a mercury vapor lamp. The devices

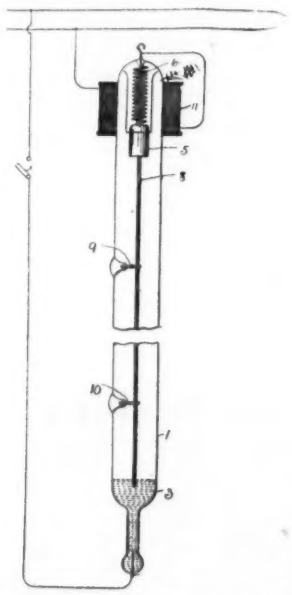


FIG. 1.—MERCURY VAPOR LAMP.

described are taken from patents granted to Recklinghausen, to the Cooper Hewitt Company, and to the Allgem. Elec. Ges., in Berlin. The arrangement of the latter company is shown in Fig. 1. The tube, 1, is filled at the bottom with mercury, 3, forming one electrode. In the upper part of the tube the other electrode, 5, is provided, which is an iron cylinder and is suspended by the spring, 6, which is in electrical connection with the magnet winding, 11, surrounding the upper part of the tube. From the electrode, 5, a rod, 8, of carbon is suspended passing through the guides, 9 and 10, and dipping into the mercury, 3. When current is started the electromagnet winding, 11, attracts the iron cylinder, 5, and the lower end of the carbon rod, 8, leaves the mercury, whereupon an arc is started between the terminal of the carbon and the mercury. On account of the very high vacuum within the tube, this arc does not remain stationary, but extends along the rod, 8, upwards until it reaches the electrode, 5. The current which then passes through the lamp is conducted largely, if not wholly, by the mercury vapor in the tube, so that the current passes through the rod, 8, practically only at starting.—*Zeit. f. Beleucht*, February 10.

*Train Lighting.*—L'HOEST.—An illustrated description of the L'Hoest-Pieper system of electric train lighting.—*La Revue Elec.*, February 15.

## Power.

*Driving Rolling Mills.*—ORTMANN, WILD, WEIDENEDER.—A discussion of the relative advantages of the steam engine for driving rolling mills and of electric driving. Ortmann and Wild conclude that only in the case of small mills is there any assurance of profit in electric driving, if a suitable power house is available, but that for larger units the charges for interest, etc., will eat up

anything saved in other directions. Weideneder gives comparative costs of driving reversing mills electrically and by means of steam engines, both with and without the use of exhaust turbines. His results are much in favor of electric driving.—From *Stahl und Eisen,* in *Iron Age,* March 8.

*Protection of Electric Motors in Mines.*—Beyling.—The first parts of a full account of the experimental tests made in a German mine on the methods of preventing explosions in mines due to sparking of electric motors and apparatus.—*Glueckauf,* January 6, 13 and following. The article on the same subject by Goetze is continued in *Elek. Zeit.,* February 22.

*Gas Engines.*—Sargent.—A fully illustrated account of the development of large gas engines in recent years. "The experimental stage has passed, internal combustion engines have come to stay. Steam turbines, reciprocating steam engines and water wheels have their place, but the internal combustion engine is destined to be prime-mover of the future."—*Jour. West. Soc. Eng.,* February.

### Traction.

*Single-Phase Traction Experiments on Swedish Railroads.*—An account of the programme of the tests which are being made on the Swedish State Railways with single-phase traction. Different kinds of trolley wire suspension are used on different parts of the line so as to test their relative merits. The tests will be made with two locomotives and two motor cars. One locomotive was supplied by the Westinghouse Company. It has two axles, each axle being driven by a 150-hp, single-phase, series motor. The locomotive carries a transformer which reduces the voltage supplied from the trolley line. The arrangement is so made that voltages of 3,000 or 6,000 or 12,000 or 15,000 or 18,000 may be taken from the line. The total weight of the locomotive is 25 tons and its dimensions are relatively small. The second locomotive was supplied by the Siemens-Schuckert Company and also carries a transformer for taking current from the trolley wire at voltages of 5,000 or 10,000 or 15,000 or 20,000, the secondary current being supplied to the motors at a voltage of from 115 to 300. The locomotive has three axles, each axle being driven by a 100-hp, single-phase series motor. The total weight of the locomotive is 35 tons. The two motor cars were supplied by the Allg. Elek. Ges. Each carries two 120-hp, single-phase Winter-Eichberg motors. The stator of the motors takes current directly from the trolley wire at 6,000 volts. There is no transformer inserted between trolley wire and motors. On the other hand, the dimensions of these high-tension motors are larger and they are heavier and more expensive; further there is the other disadvantage that they can be used only at the one voltage of 6,000. A complete list of the different problems which are to be solved by the test is given.—*Elek. Anz.,* February 15 and 18.

*London Subway.*—An illustrated description of the Baker Street & Waterloo Railway, which is one of the new tube railways in London; the total length when complete will be about 5¼ miles, with 12 stations. Down grades are provided on leaving the stations to help acceleration, and corresponding up grades to assist braking. A cross-section of the track is shown in Fig. 2. The

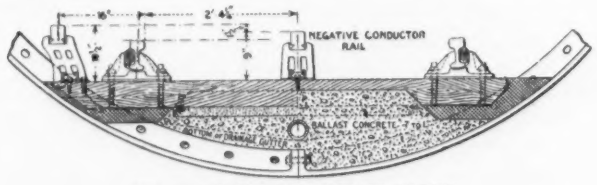



FIG. 2.—CROSS-SECTION OF TRACK.

negative conductor rail is placed in the center between the two running rails while the positive conductor rail is placed sideways of one rail. For the conductor rails a special quality of manganese steel is employed, of which the resistance is about 6.4 times that of pure copper. These rails weigh only 85 lb. per yard, as against the 100-lb. conductor rail employed on the London District Railway. The insulators for supporting the conductors are also entirely different from those hitherto employed. The positive rail outside the tra ck has a clearance of only 2½ in. from the flanges of the segments of the tube, so that a special-shaped insulator is required for the outer conductor. All the insulators are of vitrified earthenware. Malleable-iron clips are used to hold them down and felt pads ⅛ in. thick are provided. The power for working the line is supplied through three substations from the underground electric railway company's power house. Three-phase currents are there generated at 11,000 volts and are converted to about 600 volts direct current in the substations. Careful attention is paid to good ventilation and the system differs entirely from that used in the older tube railways in London. Instead of the air being drawn out from one end by a huge single fan once a day, as is done at Shepherd's Bush, fans are provided at every station and work continuously all day long. By this means a column of air in each station is being continually renewed, and as by the movement of the trains these columns of fresh air are being constantly forced into the tunnels and replaced by columns of air requiring renewal from the tunnels, practically the whole of the underground air is frequently renewed. Each fan has been designed to exhaust 1,000,000 cu. ft. of air per hour, which is sufficient to renew all the air in the average length between the stations in both tunnels every 30 minutes. As the path of suction is relatively short and the cross-section of the duct varies between 12 and 16 sq. ft., no great pressure and velocity were required, so the efficiency is relatively high. One million cubic feet of air per hour requires 8.1 hp. The Westinghouse electropneumatic system of automatic signaling is used. There are three or four elevators at each station. The control of the trains is by the standard Sprague-Thomson-Houston multiple unit system.—Lond. *Elec.,* February 16 and 23.

*Overhead Equipment.*—Tweedy and Dudgeon.—The conclusion of their paper read before the Birmingham section of the British Inst. Elec. Eng., on the construction and maintenance of overhead equipment. The authors discussed the construction of the trolley wire and trolley wire ears and the causes of the wear of the trolley wire. The depreciation due to rolling friction is almost negligible. Sliding friction may be reduced to the same negligible quantity by attention to alignment and by the universal use of swivel trolley heads of the freest type. Arcing is the most serious trouble of all, and must be discounted by the use of modified trolley wire section and a complementary trolley wheel. The effect of an impure atmosphere requires further elucidation. The method of suspension does not affect the wear, while the effects of height of wire and pressure of trolley wheel require careful examination. A large number of tables give the results of the actual experience of the authors.—Lond. *Elec.,* February 23.

*New Haven.*—An illustrated description of the Grant Avenue Station of the Consolidated Railway Company at New Haven, Conn. Although the equipment of this station is made up of different types of machinery installed over a period of nearly 12 years, it possesses special interest on account of the low power costs secured. The total cost per kw-hour is given in the six months from July to December, 1905, as .75, .76, .68, .65, .65 and .58 cent, respectively.—*St. R'y Jour.,* March 3.

*Electric Traction.*—Koester.—An illustrated review of a quarter century of electric railway engineering, discussing the important steps leading up to heavy alternating-current service.—*Eng'ing Mag.,* March.

*Electric Automobile.*—Bary.—An illustrated description of the Vedrine electric automobile which carries a storage battery as the only source of power. The system of wiring, the controller, the methods of braking, etc., are described.—*L'Industrie Elec.,* Jan-

### Installation, Systems and Appliances.

*German Central Station Statistics.*—The voluminous statistics of the central stations in Germany. In addition to an editorial review, it comprises almost 48 full pages. The statistics refer to the stations in operation on April 1, 1905. On that date there were working 1,175 plants and 540 plants were in course of construction. There are also some 80 plants from which no data could be obtained. Of the 540 plants in course of construction on April 1, 1905, about one-third are now in operation, so that the total number of working central stations in Germany is now almost 1,500. Only stations which supply cities with light or

power are included, while private isolated plants are purposely omitted. The statistical tables contain for the first time data on the rates of charging, and these data are pretty full. It appears that the flat rate with discounts is used in a majority of cases. As a typical example the central station of Aix la Chapelle may be mentioned which charges for energy for lamps 13.75 cents per kw-hour for the first 250 hours and 6.25 cents for every further kw-hour. For energy for motors the following rates are used: During the day for the first 5,000 kw-hours 3.75 cents is charged per kw-hour, 3 cents for the next 5,000 kw-hours, 2.5 cents for the next 10,000, 2 cents for the next 20,000 and 1.5 cent for every kw-hour above that. For the evening hours the following motor rates are charged: If up to 10,000 kw-hours are used daily 7.5 cents are charged per kw-hour; 6.25 cents between 10,000 and 20,000, 5 cents between 20,000 and 40,000, 4 cents between 40,000 and 80,000, 3.5 cents between 80,000 and 150,000, 3.25 cents between 150,000 and 200,000, and 3 cents for every kw-hour above that. In addition to this rate of charging, which is most generally used in Germany, the double tariff and the maximum demand tariff are used in a large number of works, while quite a number of plants—and not only small ones—supply energy on a general flat rate. In 1905 there were 53 central stations with a capacity of more than 2,000 kw; their aggregate capacity being 330,203 kw. These 53 plants are located in 40 cities. The five largest are the Berlin Electricity Works (three-phase and direct current, with accumulators), 91,971 kw; Berlin-Moabit (three-phase and direct current, with accumulators), 30,078 kw; Berlin-Oberspree (three-phase and direct current, with accumulators), 27,570 kw; Hamburg (direct current, with accumulators), 27,131 kw, and Rheinfelden, which is the largest German hydro-electric station (three-phase and direct current, with accumulators), 14,491 kw. The development of German central stations during the last 10 years is shown in the following table:

| | Number of plants. | Number of 50-watt incandescent lamps. | 10-ampere arc lamps. | Motors h.p. |
|---|---|---|---|---|
| 1894 | 148 | 493,801 | 12,357 | 5,635 |
| 1895 | 180 | 602,986 | 15,396 | 10,254 |
| 1897 | 265 | 1,025,785 | 25,024 | 21,809 |
| 1898 | 375 | 1,429,601 | 32,586 | 35,867 |
| 1899 | 489 | 1,940,744 | 41,172 | 68,629 |
| 1900 | 652 | 2,623,893 | 50,070 | 106,368 |
| 1901 | 768 | 3,403,205 | 64,278 | 141,414 |
| 1902 | 870 | 4,200,203 | 84,891 | 192,059 |
| 1903 | 939 | 5,050,584 | 93,415 | 218,953 |
| 1904 | 1,028 | 5,687,382 | 110,856 | 263,036 |
| 1905 | 1,175 | 6,301,718 | 121,912 | 310,428 |

Of the 1,175 stations in operation on April 1, 1905, there were 929 using direct current with accumulators with a total capacity of 313,058 kw. The direct-current system without accumulators was used by 44 plants; their total capacity was 2,960 kw. Single-phase and two-phase alternating-current systems were used in 43 stations of together 39,178 kw; three-phase current in 75 stations of together 89,306 kw; the monocyclic systems in two stations with 1,182 kw; the combined three-phase and direct-current system was used in 66 stations of 170,536 kw, while the combined single-phase or two-phase alternating-current and direct-current system was used in 16 stations of together 9,650 kw. The total capacity of the 1,175 stations was 625,870 kw; these plants were located in 1,133 different localities. More than one-half, namely, 630 stations, use steam and their capacity (411,716 kw) is four-fifths of the total capacity of all central stations if accumulators are not included in the capacity figure. There are 125 water power stations with a total capacity of 15,582 kw. Gas power is used in 124 stations with 11,120 kw. Both water and steam power is used in 219 stations of 61,692 kw; both water and gas power in 18 stations of 1,572 kw; both steam and gas in 20 stations of 5,167 kw. The number of incandescent lamps connected on April 1, 1905, and reduced to 50-watt lamps was 6,301,718; the number of 10-amp. arc lamps was 121,912, the capacity of all electromotors was 310,428 hp. The total connections reduced to 50-watt incandescent lamps represented 13,108,542 incandescent lamps, or 655,427 kw. The number of electricity meters in use was 269,722. The number of central stations opened to the end of 1888 was 15; there were opened 7 in '89, 8 in '90, 13 in '91, 22 in '92, 31 in '93, 36 in '94, 63 in '95, 74 in '96, 106 in '97, 152 in '98, 142 in '99, 144 in 1900, 94 in '01, 84 in '02, 82 in '03, 62 in '04, and 40 in '05.—*Elek. Zeit.*, February 15.

*Zurich.*—WAGNER.—An account of the system of electric supply in Zurich. There is an absolute separation for the power employed for lamps from that employed for motors. The old single-phase network is reserved entirely for the lamp service, while the three-phase currents used for motors come from the Benznau station and are transmitted at 25,000 volts to transformer sub-stations at Guggach and Albishof, where the voltage is reduced to 6,000. From these sub-stations the current is led by means of cables to three sub-stations within the city, where the voltage is reduced to 500 for supplying current to the city network. In case of an accident at the Benznau station, the sub-stations can be supplied from the city plant, where a turbo-generator set of 1,500 kw has been installed for this purpose, giving three-phase currents at 2,000 volts, which can be transformed up to 6,000 volts and transmitted to the sub-stations at Guggach and Albishof. Two of the three sub-stations installed in the city are provided each with three converters of 600 and 900 kw for traction purposes and with batteries having a capacity of 1,000 amp.-hours.—From *Schweiz. Elek. Zeit.;* in *L'Industrie Elec.*, January 25.

*British Central Station.*—An analysis of last year's account of the Charing Cross, West End & City Electricity Supply Company. The company has two stations which supply each other to some extent in bulk at times of high load on one station. The total kw-hours sold to consumers were nearly 15,500,000. The total works cost per kw-hour sold to customers was 2.22 cents; the total costs, excluding capital charges, 3.18 cents.—Lond. *Elec.*, February 23.

## Electrophysics and Magnetism.

*Canal Rays.*—J. J. THOMSON.—An account of an investigation of the properties of canal rays obtained by means of a perforated cathode; the rays are allowed to impinge upon a charged metal plate mounted in an auxiliary tube at an angle to the path of the rays. When the canal rays strike against a solid they cause it to emit cathode rays moving with small velocities. This can easily be shown by charging the metal plate against which the canal rays impinge negatively to a potential of, say, 80 volts, then from the part of the plate struck by the canal rays a pencil of feebly-luminous rays can be seen. These rays are easily deflected by a magnet in the direction indicating a negative change. The canal rays ionize the gas they traverse, and the presence of electrons is proved by the deflection of a portion of the beam towards the plate when charged positively. When the canal rays, consisting as they do of positive ions, lose a certain portion of their velocity, they combine with electrons to form uncharged molecules or atoms. This critical velocity is about the order of 10 cm. per second, but is higher in the alpha rays of radium. The canal rays disintegrate a metal plate against which they strike, for after a long-continued bombardment of the metal plate the walls of the tube in the neighborhood of the plate are found to be covered with a deposit of the metal. When the canal rays impinge on a salt of sodium, the salt gives out yellow light, in which the D line is very bright. It is remarkable that this line is not given out when canal rays impinge on the metal sodium itself. A mirror of sodium with specks of oxide on it presents a beautiful appearance when struck by these rays. The spots of oxide shine out brightly with a greenish-yellow light, while the surface of the metal itself seems quite dull if no external light falls upon it.—Lond. *Elec.*, February 16; from *Proceedings Cambridge Phil. Soc.*, January 31, 1906.

*Faraday and Kerr Effects in the Infra-Red Spectrum.*—INGERSOLL.—An account of a study of electromagnetic rotary dispersion, particularly in the infra-red spectrum. The chief results are summed up as follows: The electromagnetic rotatory dispersion of carbon bisulphide has been measured by infra-red methods over a range of spectrum extending from the sodium lines to $\lambda = 4.3\mu$, and found to be correctly represented by a formula which takes account of the absorption band beyond $8\mu$, showing that an infra-red absorption band may effect the rotary dispersion, much as it does ordinary dispersion, over a considerable range of spectrum. The magnetic metals and magnetite show, after wave length $1\mu$ in the infra-red, a decrease of the Kerr rotation with increase of wave length. The complete ro-

tatory dispersion curves, made by supplementing the results for the infra-red by existing observations for the visible spectrum, show a marked resemblance to a typical dispersion curve in the region of an absorption band, indicating the existence in metals of something analogous to a region of resonance absorption, extending over the visible spectrum. The particular cases of nickel and magnetite are notable, for the rotation appears to vanish for a particular wave length in each case, and then change in sign. The Kerr rotation for the magnetic alloy, Heusler's metal, if it exists at all, is less than one-tenth of that for iron or steel, although the magnetic properties of the metal are quite comparable.—*Phil. Mag.*, January.

*Gravitational Energy.*—Cremieu.—The radiation resulting from the acceleration of electrons implies a degradation of energy, and the author puts the question as to whether a corresponding degradation of energy can be traced in connection with the generation or destruction of gravitational energy. If it cannot, then gravitational energy is the only form of entirely reversible energy hitherto known. He has endeavored to approach this question experimentally along several different lines of investigation. One of them consists in determining the gravitational constant in liquids, where it should be the same as in air in accordance with hitherto accepted opinions. He succeeded in determining the constant in water under favorable conditions, but could not obtain any decided indication of an effect of the medium. He also endeavored to detect some effect of the abrupt acceleration by free fall of the attracting body, arguing that by Lenz's law the energy liberated would produce a motion in the attracted object tending to oppose the relative motion. He looked for an impulse of the attracted object in the direction of the fall, but failed to find it. In another experiment he formed in a bath of olive oil, several drops of a mixture of alcohol and water of the same specific gravity as the oil, and found that they were apparently attracted toward each other, although neither capillarity nor ordinary gravitational attraction could be alleged as the cause of the attraction.—Lond. *Elec.*, February 2; from *Jour. de Physique*, January, 1906.

*Determining Dielectric Constants.*—Veley.—A description of a modified form of apparatus for the determination of the dielectric constants of non-conducting liquids. The method consists essentially in producing a balance between two capacities and two capacity-free resistances. Both resistances are kept constant and one capacity is varied concomitantly with the other, the capacities being measured in terms of a length according to the principle that ceteris paribus the capacity of a condenser varies inversely with the distance between the metallic plates provided that such distance is small relatively to the area of the plates. The results obtained with the method are satisfactory.—*Phil. Mag.*, January.

### Units, Measurements and Instruments.

*D'Arsonval Galvanometer.*—Wenner.—An abstract of an Am. Phys. Soc. paper in which the author describes the use of the D'Arsonval galvanometer with a particular adjustment for ballistic work which has some important advantages. The coil is stripped of its dampers, so that its motion is but little damped when on open circuit. The relation between the coil constant, the suspension constant, the strength of the field, the moment of inertia of the coil and the resistance of the coil is so adjusted that the coil comes to the zero position in the least time without swinging past it. It is also desirable to have the period of the coil as large as 15 or 20 seconds. To make the period as large as this often requires the use of a small suspension or an increase in the moment of inertia of the coil. Unless the coil has a very large moment of inertia in proportion to the copper in it or swings in a very weak field the adjustment may be completed by putting the proper resistance in series with the coil. This resistance may be determined by using different values and observing the swing of the coil past the zero when released from a certain deflection. If resistances are plotted as ordinates and the swings past the zero as abscissa, the point where the curve meets the "y" axis gives the resistance. With this adjustment the ballistic constant is $e$ (base of Naperian log.) times as large with the coil on closed circuit as when on open circuit. The constant may be determined by the solenoid method, a condenser and standard cell. The galvanometer may be used either on closed or open circuit work with the same constant except the factor $e$. When used on condenser work the coil may be quickly brought to the zero by closing the coil circuit. When used on closed circuit work, such as iron testing and induction experiments, the coil returns to the zero position without attention about as fast as readings can be taken and recorded.—*Phys. Rev.*, March.

*Localization of Faults.*—Boehm-Raffay.—A mathematical article, illustrated by diagrams, on localization of faults by the Wheatstone bridge arrangement.—*Elek. Neu. Anz.*, February 15.

### Telegraphy, Telephony and Signals.

*Wave Length in Wireless Telegraphy.*—Round.—The following factors determine the choice of the wave length: terminal conditions, interference from natural electrical discharges, interference from other stations, distance to be worked, and the nature of the surface to be worked over. The chief limiting terminal condition is the impossibility in certain circumstances of constructing a radiator which is properly efficient. The most serious trouble that practical wireless telegraphy has had to contend with up to the present time is natural electrical discharge. It is nearly always possible in practice to work even with faint signals with wave lengths under 500 ft. in length, the only exception being when a heavy thunderstorm is in proximity to either of the working stations, but the use of these short waves is limited to about 100 miles sea range. Wave lengths of the order of 1,000 ft. are more seriously interfered with, and when waves of 5,000 ft. are used electrical discharges can be heard practically at all times, and in the summer time would interfere seriously with the reception of all but the very strongest of signals.—Lond. *Elec.*, February 16.

*E.M.F'S in Wireless Receivers.*—Tissot.—When a receiving antenna is earthed and exposed to waves from a tuned sender, there is a stationary wave in the receiving antenna, exhibiting a node of current intensity at the summit and a ventral segment at the base. The potential, on the other hand, has a ventral segment at the summit and a node at the base. If $l$ is the length of the antenna, $r$ its radius, $V$ the effective potential and $i$ the effective current, as indicated by a bolometer or other thermal instrument, the equation holds $V = 2L \frac{21}{r} i$. Tissot succeeded in measuring the effective e.m.f. at the summit by a direct idiostatic electrometer method. It was 4.6 volts, the stations being 1 km. apart, the receiving antenna 70 meters long and the spark length 5 cm. The theoretical value was 4.4 volts. The author also measured the effective voltage in a "jigger," or secondary coil influenced by the induction of the receiving antenna, and found it to be of the same order of magnitude as in the antenna itself, viz.: from 4 to 5 volts, at a distance of 1 km.—Lond. *Elec.*, February 23; from *Bull. Franc. de Phys.*, January 19.

*New Telephone Exchange.*—An account of the recent change over of all the subscribers on the London Post Office "Central" exchange to the "City" exchange, the number of subscribers and junction lines transferred being about 14,000. The change over took place on a recent Saturday afternoon.—Lond. *Elec.*, February 23.

*Tuning of Wireless Telegraph Apparatus.*—A summary of the chief results of the last three papers of Slaby's serial on this subject, all of which have been noticed in the Digest from the original German publication.—Lond. *Elec.*, January 26.

### Miscellaneous.

*Removal of Salamander from a Blast Furnace.*—Smith.—An illustrated discussion of various methods for this purpose. The author mentions drilling with the electric arc. If a carbon supplied with an electric current of proper voltage and in proper quantity be used as a burner on a metallic mass, the mass can be cut by melting, at a very rapid rate. In recent years advantage has been taken of this to bore holes through the walls and into the tapping hole of furnaces which have become partially chilled. The best results have been obtained with alternating current at 50 volts or less and with 1,000 amp. of current, the carbon rod

being three inches in diameter by six feet long.—*Am. Machinist*, February 22.

*Magneto Ignition.*—A description of the Rankin Kennedy system of magneto ignition for internal combustion engines, the spark being obtained in the cylinder by means of a high-speed magneto machine working in conjunction with a tremble coil.—Lond. *Eng'ing*, February 16.

*Electric Ignition.*—LITTLE.—A paper read before the Newcastle section of the (British) Inst. Elec. Eng., discussing the systems now in use of electric ignition for motor cars.—Lond. *Elec.*, February 16.

## BOOK REVIEWS.

DIE ELEKTRISCHEN BOGENLAMPEN. DEREN PRINZIP, KONSTRUKTION UND ANWENDUNG. By J. Zeidler. Braunschweig: Friedrich Vieweg und Sohn. 140 pages, 130 illus. Price, 5.50 marks.

The arc-lamp exists in so many different forms, and is capable of being studied from so many different points of view, that no single text-book can cover the entire subject. This book is written from the standpoint of the electric lighting engineer, and devotes special attention to the distribution of illumination from arc lamps. The various types and constructions of lamps are considered, the duration of their carbons, and the distribution of their luminous intensity. The unit of illumination employed is the lux defined as a Hefner-metre. The unit flux of light is a Hefner-lumen. The description is clear, and the illustrations are excellent. The book will be valuable to students of the technology of electric illumination by arc-lamps.

LE FOUR ELECTRIQUE. By Adolphe Minet. Paris: A. Hermann. 76 pages. illustrated. Price, 5 francs.

The electric furnace has only recently come into commercial use on a large scale, but its origin on an experimental scale goes back to the beginning of the nineteenth century, in researches on the then new voltaic arc. In the little treatise the author has given an outline of the history of the electric furnace, a brief account of its principal recent applications, and a brief collection of electrochemical tables and formulas. Photographically reproduced portraits are also appended of Minet (the author), Siemens, Huntington, Clerc, Borchers, Héroult, Cowles and C. M. Hall. This collection of portraits gives the book special interest for electrometallurgists. The text is clear and well illustrated by about fifty cuts. The book will be welcomed by students of electrochemistry and of the history of that art.

THEORIE DER ELEKTRIZITÄT. By M. Abraham. Vol. II. Leipzig: B. G. Teubner. 404 pages, 5 illus. Price, 10 marks.

This second volume of the author's "Theory of Electricity" is principally devoted to electrons and the electronic theory. The method of treatment is essentially mathematical, and vectorial analysis is largely employed. Starting with Maxwell's theory of the electromagnetic field, the experimental results of Hertz, Zeeman, Townsend, Thomson and Wilson are discussed and collated into a new theory of electricity which is in all main features an electron theory. The treatment is very skillful, and the author is to be congratulated upon the thoroughness of the work. The second section of the book deals with electric waves and their connection with optical phenomena. The mathematical treatment being somewhat abstruse will necessarily restrict the use of the book to advanced students. It will, however, well repay the study required for its comprehension.

THE TELEGRAPHIST'S GUIDE. By James Bell and S. Wilson. London: S. Rentell & Co. 227 pages, 197 ills. Price, 50 cents.

This is a very handy and very practical little manual intended for the use of telegraphers in Great Britain. Telegraphists in Great Britain, aspiring to superior appointments in the telegraph service, are required to pass a technical examination, and this manual is designed to meet the standard requirements of that test. The book now appears in its fifth edition. The first chapter is devoted to voltaic batteries, their nature, tests, grouping and maintenance. The second chapter deals with simplex signaling apparatus. The third covers duplex telegraphic working; the fourth, quadruplex; the fifth, Wheatstone; the sixth, repeaters; the next three, testing, and the last, wireless telegraphy. The treatment is simple in character and almost devoid of mathematics; but is clear, full, modern and comprehensive. There is a good glossary of technical terms and index of subjects. The book will be of much value to those who are interested in the practical telegraph apparatus of Great Britain.

DIE ELEKTROCHEMIE DER ORGANISCHEN VERBINDUNGEN. By Dr. Walther Löb. Halle: William Knapp. 320 pages, 10 illus. Price, 9 marks.

This is the third and enlarged edition of a very useful work. Organic chemistry has profited much by the short cuts and direct processes which electrochemistry offers, and is even beginning to count on quantitative outputs by the assistance of this new reagent. Dr. Löb has systematized and put in very accessible form the various items of scattered information which have so far appeared. He divides the subject into the necessary sections of electrolytic processes and electrothermic processes. The former are classed under six chapters; viz., theoretical, methods, electrolysis of aliphatic compounds, electrolysis of aromatic compounds, electrolysis by alternating current, and electrical endosmose. The latter is treated under the headings of theory and methods, spark discharge and arcs, utilization of electric heat from solid conductors, the silent discharge and action of Tesla currents. Electrochemical literature has been materially enriched by the work of Dr. Löb; and although an English translation is promised, yet anyone interested in the use of electricity in organic chemistry should certainly obtain and read this book without delay.

LEÇONS D'ELECTROTECHNIQUE GÉNÉRALE. Professées à l'Ecole Supérieure d'Electricité. Tome II. Courants Alternatifs Series oï daux et Non-Series oï daux Alternateurs. Transformateurs. Deuxiéme Edition. By Paul Janet. Paris: Gauthiers Villars. 309 pages, 156 figures.

That M. Paul Janet is an accomplished electrician is well known on both sides of the Atlantic. It is therefore no surprise to find that this second volume of his revised work on general electrotechnics fully sustains the reputation he has acquired for lucidity of expression and thoroughness of treatment. The phenomena of alternating currents form a branch of inquiry which demands a fair amount of mathematical knowledge at the very outset. Given such requisites as readiness in handling analytical formulæ and some familiarity with graphical methods, M. Janet's presentation of the subject will be found profitable and enjoyable reading. In successive chapters, he talks of harmonic functions, currents that follow the sine law and those that do not, polyphase currents and their applications, alternators and transformers.

Appended to four of the eight chapters is a lengthy bibliography including works and papers of the best known Americans and European contributors to our knowledge of the theory and applications of alternating currents.

ELECTRIC WIRING, DIAGRAMS AND SWITCHBOARDS. By Newton Harrison, New York: The Norman W. Henley Co. 272 pages; 105 illus. Price, $1.50.

This work is a treatise on the subject of electric wiring in all its branches, beginning with the simple circuit and working up to practical every-day problems, all being presented in a simple and intelligent manner. Only arithmetic and simple algebraic formulas are used in the calculations and explanations. Some originality is shown by the author in the method of presentation of the matter, the liberal use of tables helping to a clear understanding of the subject. The diagrams, although on old subjects, are shown in a new form which will be found very helpful in the comprehension at a glance of facts that many persons might find difficult to understand if stated only in words.

While more than half of the work is devoted to wiring and related subjects, there is a good deal of other information that will be found generally useful. There is a chapter on incandescent lamps, which includes tabulated data on this topic. Switchboards of the various types, their design, etc., are considered in three chapters and the accompanying diagrams are clearly executed and easily understood. The three final chapters briefly review the nature and characteristics of alternating currents, and their practical applications are described.

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Die Formelzeichen. By Olof Linders. Leipzig: Jäh & Schunke. 96 pages, tables. Price, 5 marks.

The author presents in these pages a table showing the various symbols which are in current use among technologists in different countries, for representing physical quantities in algebraic formulas. No less than 871 physical quantities appear in the table. To each is given its dimensional formula in the c.g.s. system, and also the symbol under which it is represented in 12 different sources of literature, as well as in the new system proposed by the author. Of the sources referred to, three are German pocketbooks, two are English and two are French. There are also five German or Austrian technical societies quoted.

The electromagnetic units are duly scheduled to the number of about 160. Unfortunately for electrical engineers, the symbols proposed by the author differ in a number of cases from those which he shows to be in general use among electrical writers. Of course, it needs no comment upon a table of nearly 900 symbols, that in order to avoid repetition, havoc must be created here and there in the existing usage of symbols and formulas. Only by mutual compromise between different scientific workers and technologists can a comprehensive uniform system of symbols be brought about.

The author has done good service in presenting this tabulated list of sybmbols, if only by paving the way towards uniform action in the future. The book will be of much interest and utility to great numbers of technologists, engineers and students in different departments of applied science.

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La Théorie Moderne des Phénomènes Physiques. Radioactivité, Ions, Électrons. Par Augusto Righi. Traduit de la 2 iéme édition Italienne par Eugène Néculea. Paris: *Eclairage Electrique*. 126 pages, 19 illus. Price, 3 francs.

This pamphlet of 126 pages may be appropriately called an inquiry into the mechanism of physical phenomena or into the constitution of matter itself. Before stating any conclusion as to the probable nature of the simplest form of ponderable matter, Prof. Righi treats successively of electrolytic ions and electrons, cathode rays, radioactivity; mass, charge and velocity of ions and electrons.

It will be seen here that we have all the elements of an essay on contemporary physics to which must be added that the essay was written by a masterly hand, Prof. Righi himself being an ardent worker in the electronic field.

We note that he writes modestly, not emphatically, still less dogmatically, about the new views which constitute the electronic theory of matter; for, admitting the possible existence of an entity quite distinct both from matter and ether, he is careful to state that the new theory has only just made its *début* and that it would be premature to consider it as affording anything like a sure basis for a new system of natural philosophy.

No one knows what the intimate nature of the electron or electric atom is; but, according to the high priests of the new views, it is something very complex indeed, resembling a cosmic system of infinitesimal dimensions. The structural complexity of the postulated entity which is neither matter nor ether does not greatly encourage the hope that it will be able to reveal to us the supreme reason of things. But, failing that, it will serve a useful purpose, by co-ordinating and correlating the various branches into which we still divide the wide domain of physical research.

The work is translated from the Italian by M. Eugène Néculea of the research laboratory of the Sorbonne, and opens with a four-page introduction by Prof. Lippman, of the University of Paris.

## General Electric Oscillograph.

The accompanying illustrations show a compact form of the oscillograph of the vibrating loop type, manufactured by the General Electric Company. This oscillograph is similar to a D'Arsonval galvanometer in that it has a current carrying circuit located in a powerful magnetic field. The part corresponding to the moving coil in the galvanometer is replaced by two small moving strips which also act as a suspension and carry the mirror. In a light tight box (See Figs. 1 and 2) is placed a three-element galvanometer of this design, combined with devices for viewing or photographically recording current and electromotive force waves. Each galvanometer element, or vibrator, consists of a single loop of very fine ribbon, *B*, suspended vertically in a powerful magnetic field. The terminals of the galvanometer are the ends of this loop, which is held at its lower extremity by an adjustable pulley.

With the exception of the magnetizing coils, each galvanometer element in the set of three is entirely complete and can, therefore, be easily insulated. Each set of vibrating strips is exposed

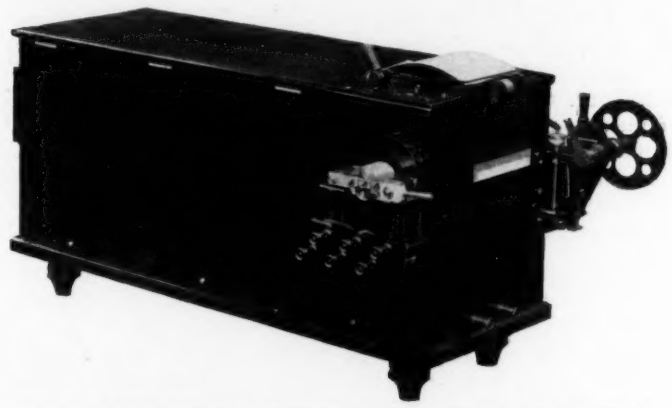


FIG. 1.—OSCILLOGRAPH, SHOWING PHOTOGRAPHIC AND TRACING ATTACHMENTS.

on all sides when removed from the containing cells, so that any required adjustments or repairs are most conveniently made.

Light, usually from an arc lamp, is thrown by a lens upon prisms, and by them to the oscillatory mirrors of the galvanometers. From these mirrors the rays are reflected horizontally to the photographic drum at the opposite end or to a synchron-

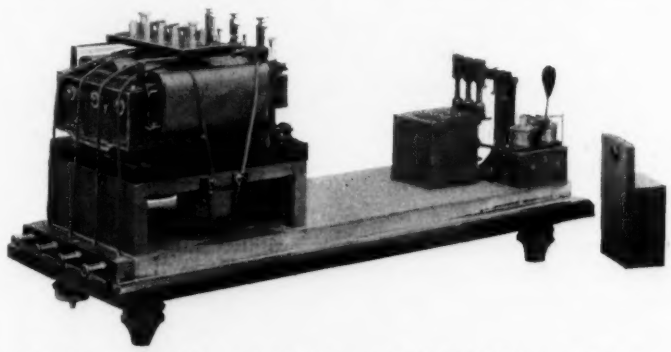


FIG. 2.—INTERNAL ARRANGEMENT OF OSCILLOGRAPH PARTS.

ous mirror from which they are reflected upward to a surface where they can be observed or traced.

The vibration of these oscillatory mirrors produces three lines of light, the amplitude of their vibration measuring the strength of the current or electromotive force. To produce a wave photographically, a drum carrying a sensitized film is revolved in the path of these light rays thus forming the abscissæ of the projected wave.

The same shaft which carries the photographic drum operates a set of contacts which actuates a shutter interposed between the light source and the condensing lens. This shutter-operating mechanism is so arranged that the shutter is open during one revolution of the drum.

For viewing recurring waves, as has been stated, a so-called synchronous mirror is provided. This may be easily swung into position by a lever without removing the photographic recording device. The synchronous vibration of this mirror, which is oscillated by a cam driven by synchronous electric motor, provides the necessary range of action along the axis of abscissæ and thus gives an image of the wave form.

Such an apparatus is useful in studying the action of the various phenomena in electric circuits having not more than 5,000 or 6,000 complete vibrations per second. The accompanying oscillograms, Figs. 3 and 4, show the application of the General Electric oscillograph to various phases of engineering in which this method of ascertaining hidden electrical conditions has been found highly valuable. The enormous increase in the

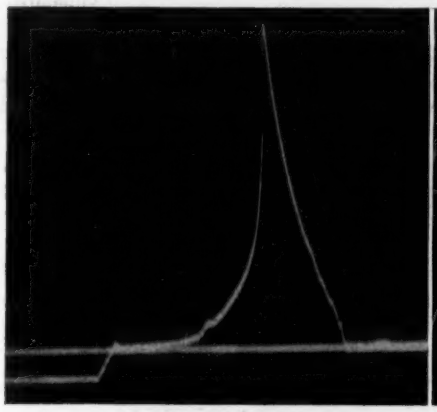


FIG. 3.—OSCILLOGRAM OF INDUCTIVE INCREASE IN VOLTAGE UPON OPENING CIRCUIT.

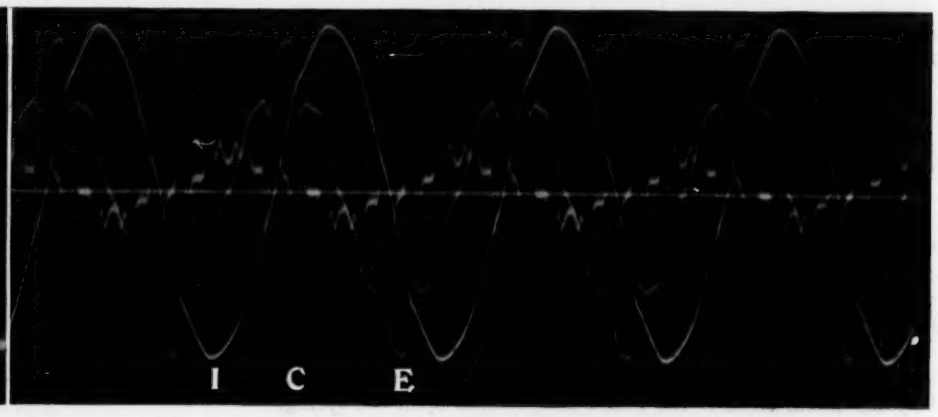



FIG. 4.—RECORDS OF E.M.F. AND OF CURRENTS THROUGH INDUCTIVE AND CONDENSIVE CIRCUITS.

reversed voltage across the field winding of a shunt motor when the circuit was opened by a quick-break switch is indicated in Fig. 3. The curve, *E*, of Fig. 4, shows the instantaneous record of the electromotive force wave in a certain circuit. Curve *I* shows the almost sinusoidal current which the distorted e.m.f. sent through an inductance coil, while curve *C* indicates the current which the same e.m.f. sent into a condenser. The effects of the inductance in decreasing the distortion and of the condenser in increasing the distortions are strikingly shown by a comparison of curves *I* and *C*.

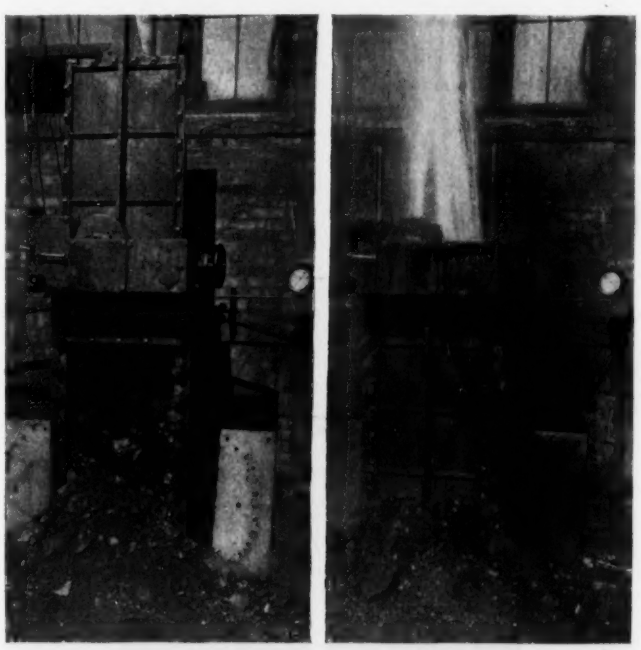
## Tests of Electrically-Operated Bulkhead Doors.

The U. S. Navy Department, through the Bureau of Construction and Repair, lately conducted some elaborate tests of the "Long-Arm" power door, which type is installed on United States warships. In the tests the conditions were reproduced existing aboard ship when the coal bunkers are full and the doorways between the bunkers and the fireroom are open and choked with coal. The test included also a reproduction of the situation which would arise in the event of a hull puncture admitting water sufficient to sweep the coal through the doors.

Before proceeding with the coal and water tests the door was operated continuously for a period of several days, during which time it was opened and closed over 3,000 round trips, the equivalent of about ten years of actual service on a warship. During this trial all that was necessary to keep the door in perfect operative condition was to oil several of the bearings once a day (that is, about once for each 700 round trips). The controller received no attention whatever and the contact fingers were found in excellent condition at the end of the test; the motor also received no attention during the entire test. The worm and the wormwheel, by which power is immediately applied to the door, were lubricated before the test started and not at all during the test, and they were found in excellent condition at its completion. Immediately before making the trials for the Bureau of Construction and Repair, a duplicate of the prescribed tests was carried out by the "Long-Arm" System Company to make sure that everything would run properly, and thus the particular door passed through a series of openings and closings equivalent to twenty years actual service upon a warship without showing appreciable wear.

The box upon which the door was mounted was filled with coal, allowed to run out through the door opening in the same way that it would if the door were opened from a coal bunker. Large lumps of coal were mixed with the layer of all sizes. Before closing the door upon this mass of coal, fine coal dust was shoveled and thrown up all over the tighteners and the frame in order that the conditions of the test might be as severe as possible. To make the coal dust stick in sufficient quantity, the bulkhead frame and tighteners were covered with thin oil.

The door was then closed from the bridge emergency station; the door plate cut through nearly all the coal, and the clear opening was practically completely closed when the automatic cut-out opened the circuit and stopped the motor. After the door had closed into the coal and been stopped by an automatic cut-out, the water from an elevated tank was let in the box back of the door plate and a head of 35 ft. above the sill was maintained. A thin film of spray worked its way through the clearance space between the bulkhead frame and door plate, and in some places the water succeeded in washing out the fine coal dust which had collected. At this time the actual leakage measured less than 75 gallons per minute. The water back of the door plate soon worked its way down through the coal to the slight opening at the bottom and washed away the pile of coal in front, thus relieving the resistance to the thrust of the door plate, causing the automatic cut-out to throw in the current again, and allowing the door to complete its closure.



ELECTRICALLY-OPERATED BULKHEAD DOORS.

During another test the door was clean, as would be the case on a passage door, and the leakage under this condition was remarkably small. The tests described showed that one of the reasons why the door works so perfectly on a coal bunker is because the motor is protected by an automatic cut-out which opens the circuit as soon as the load upon the motor becomes greater than it can safely handle, and when the load decreases to a safe amount the circuit is automatically closed again by the same device. It was shown by the tests that the cut-out gives to the door an almost human intelligence in its action when operated from the emergency station. For instance, when the door closed into a mass of coal and struck a lump so large that it could not cut through it, the circuit to the motor was opened; but nevertheless the device was not inoperative, for when water got into the bunker back of the coal, it at once loosened the mass of coal beneath the door plate. As soon as this was done the pressure upon the plate was relieved, the circuit again closed, the motor again started and complete closure of the door effected, as if the work had not been interrupted.

The principle upon which the automatic cut-out is based and its mechanical construction are really very simple. The motor is directly connected to the worm engaging the wormwheel already referred to, which in turn transmits the load through its shaft and a pinion to a pin rack upon the door plate. In performing its work, the worm exerts a thrust in the direction of its axis, and this thrust is borne by a specially constructed bearing supported by a heavy helical spring. This spring has upon it an initial load equal to the greatest thrust which it is desired that the motor should deliver. As soon as the thrust actually exerted by the worm exceeds the initial compression upon the spring, the latter gives way slightly, allowing the wormshaft to move axially. This motion of the wormshaft is used to interrupt the circuit, and the same motion in the reverse direction (when the excess load is removed) will complete the circuit which it has previously broken.

## Small Power Motors.

The Westinghouse Electric & Manufacturing Company has lately perfected a line of motors for light power service, such as operating sewing machines, dental apparatus, coffee grinders,

FIG. 1.—ENCLOSED MOTOR.

small ice cream freezers, phonographs, sign flashers, moving window novelties and hundreds of other adaptations. The smaller sizes may be attached to an ordinary incandescent lamp circuit, furnishing a profitable day load for lighting companies.

These motors, which follow very closely the design of the Westinghouse fan motors, are built for both alternating and direct-current circuits, either 115 or 230 volts. The direct-current motors are either shunt or series wound, and the alternating-current motors are wound for 25, 60 or 133 cycles. The efficiency of all machines is claimed to be exceedingly high.

The base of the motor consists of a separate casting, the frame being drilled and tapped so that the feet may be fastened in any one of four different positions. This construction adapts the motor for mounting in any position. The screw holes in the base are slotted to allow belt adjustment. A two-step grooved pulley, suitable for a cord or round belt, is supplied with each motor. The speed obtained by driving from the larger step is about twice that of the smaller.

The bearings are self-oiling and similar in construction to those of the fan motors. They are provided with vertical oil cups with a wick which effectually lubricates the shaft, and a suitable return channel prevents the dripping of oil from the bearings. The leads are brought out through hard rubber bushings and connection to the motor is easily made. An ordinary lamp cord and

FIG. 2.—MOTOR-DRIVEN COFFEE GRINDER.

plug may be attached to the motor leads for connecting it to an incandescent socket or receptacle.

All motors are finished in black enamel with the trimmings of brass, allowing them to be installed where neat appearance is essential.

The alternating-current motors are of the single-phase induction type with open end frames and split-phase winding, the starting coil of which is automatically cut out as the motor comes up to speed. A self-acting friction clutch engages the load after partial speed has been attained. One of these, shown in Fig. 2, is driving a coffee grinder. The direct-current motors are enclosed and are made both series or shunt wound, and are so constructed that no starting device is necessary. One of this type is shown in Fig. 1.

## Electrical Pumps for New York City.

The equipment for the two new fresh and salt water high pressure pumping stations for the Borough of Manhattan, which will consist of ten multi-stage, centrifugal pumps furnished by the Allis-Chalmers Company, of Milwaukee, will be driven by ten 800-hp "Bullock" induction motors, built in accordance with the specifications of the Department of Water Supply, Gas & Electricity and provided with a device by which resistance can be inserted at starting to limit the current taken from the supply lines. The ten pumps to which these motors are to be direct coupled, will each be constructed with six runners; i. e., the water will be handled in six stages, each stage raising the total

required amount of water through one-sixth of the total required head. The pumps are designed to give their maximum efficiency when delivering 3,000 gal. of sea water each per minute, at a speed of approximately 735 r.p.m., and against a discharge pressure of 300 lbs. per square inch.

This equipment of motor driven pumping units, which is remarkable for the size of its motors and its water lifting capacity, will be installed in the new Gansevoort and Oliver Street stations which are identical in arrangement. Each station is designed to accommodate, in all, eight complete units, of which five will be installed at the present time.

## Electromagnetic Friction Clutch.

Friction clutches are often of great advantage on line shafts to drive counter-shafts, and especially on counter-shafts to drive individual machines to be started or stopped at the will of the operator. When such clutches are used on main shafts, the

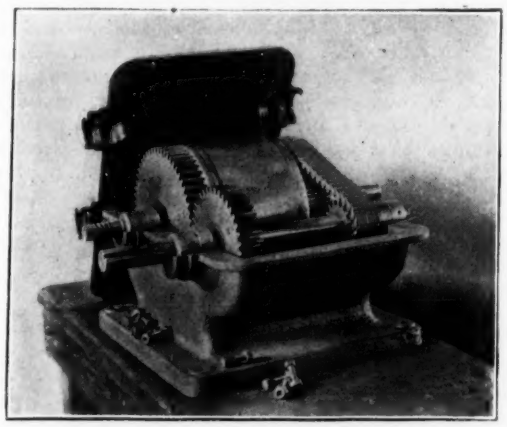


FIG. 1.—INTERIOR VIEW OF ELECTROMAGNETIC CLUTCH.

machinery of each department served by the shaft can be started or stopped independently of the others. Clutches have also found a useful application in the reverse motions for planers, automobiles, hoisting machines, printing presses, machine tools, etc. Experience has shown that friction clutches of the magnetic

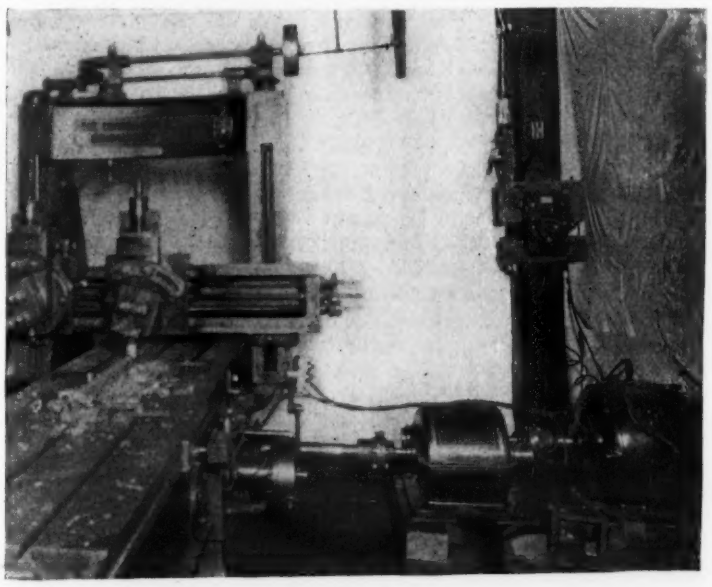


FIG. 2.—ELECTROMAGNETIC CLUTCH DRIVING PLANER.

type possess advantages which cannot be embodied in other types. The accompanying illustrations show a self-demagnetizing electromagnetic friction clutch, which has recently been placed on the market by the Pick Electric Co., Yonkers, N. Y.

The mechanical arrangement of the clutch is indicated in Fig. 1. There are two shafts, designated as the driving and the driven, respectively. On the driven shaft is directly keyed an electromagnet having two coils, one at either end, each of which is provided with a separate magnetic circuit. The magnetic circuit for one coil is completed through an armature which runs free on the driven shaft, but is directly geared to the driving shaft, and which runs constantly in one direction. The armature at the other end of the driven shaft is connected by silent chain to the driving shaft, and it runs constantly in the opposite direction. The driven shaft will run in one or the other direction,

FIG. 3.—"LILIPUT" CLUTCH CONTROLLER.

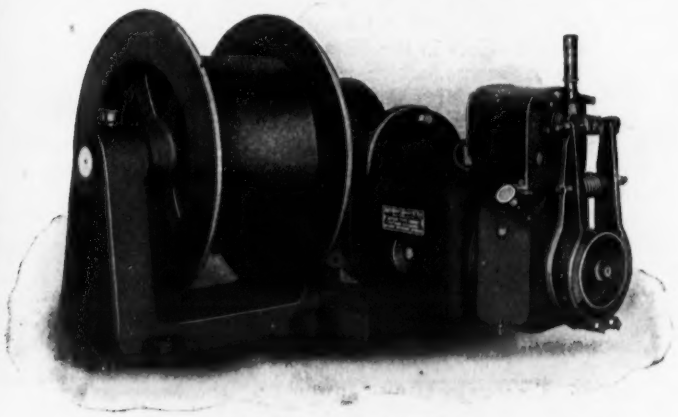
according to which coil of the electromagnet receives current.

The clutch releases at once as soon as the current is interrupted, which is a leading feature of this type of clutches. The whole clutch mechanism is enclosed, and the moving parts are surrounded by oil.

Fig. 2 shows a Pick electromagnetic clutch, used to transmit power from an "Interpole" motor to a "Cincinnati" planer. In connection with this equipment there is used a "Liliput" clutch controller (shown in Fig. 3), which is operated by the moving table of the planer, and causes the current to flow through one or the other coils of the electromagnet, according to the desired direction of the motion of the planer.

## Winding Drum Hoists.

The Sprague Electric Company, New York, manufacture several styles of electric winding drum hoists, and one of the most recent types is shown in the accompanying illustration. Hoists of this style require to be fastened securely to a foundation when in use, but they can be mounted upon a movable platform, truck or car, and thus be made portable between hoisting operations. They are used on boom derricks for raising both the load and the boom, as whip hoists, to raise loads rapidly through a hatchway, or in the open, and on docks, on board ships or in buildings. They can be used out of doors without protection from



WINDING DRUM HOIST.

the weather, as they are entirely enclosed and are dust and moisture-proof. The controller, shown on the hoist motor, can be located in any desired position regardless of the location of the hoist, thus affording the utmost convenience in operation. Standard winding drum hoists are rated for single rope with maximum pull of ½, 1½ and 2½ tons.

# Industrial and Commercial News

## *Commercial Intelligence.*

THE WEEK IN TRADE.—Spring jobbing was very active, exceeding last year's business at all markets. Some slight irregularities are noted in trade reports, but they are seasonable and are to be expected at his time of the year. A good indication of business conditions is the fact that mercantile collections are generally prompt. A little conservatism regarding forward business in some industries may be attributed to high prices, although the greatest strength appears in building materials, and preparations for structural work are beyond precedent. The few minor strikes do not seriously interfere with progress, and thus far the only noticeable effect of the coal controversy is the unusually large demand for this season of the year in all fuel markets and the disposition of small merchants in the immediate vicinity of the anthracite mines to allow stocks to become depleted. There is little idle machinery in any of the leading manufacturing industries, and contracts for distant delivery come forward freely, except at the textile mills, where purchases are chiefly for immediate requirements. Winter wheat crop reports are excellent; prices, except of some country produce, wheat and flour among breadstuffs and bleached cotton goods, show notable strength. Production of iron is enormous, probably more than was anticipated, but shipments are heavy and stocks are light. Bar iron is still weak, while old material in general continues to decline. Demand for structural material is good, specifications are plentiful, and some large orders are in sight. Sales of steel rails are rather heavy, considering the recent activity in that department of the industry, orders from trolley lines being a feature. Bituminous coal is in better demand, especially in the West, and railroads in the producing districts of Indiana and Illinois are carrying large quantities. The undertone of the market for copper is firmer, but the buying movement is not especially heavy. Chinese holders of American copper are reported to have made sales to Europe at a concession in price. Prices are firm, with a disposition on the part of several producers to advance prices ¼c. a pound. Latest quotations for lake and electrolytic for future delivery are 18½c.; prime casting grades, 18¼c. Business at copper and brass working plants in New England and the Middle States is active, the electrical trades being far in the lead in demands for high-grade copper. Machinery and machine tools are in good demand, and plants are well engaged ahead. *Bradstreet's* reports 177 business failures during the week ending March 8, as compared with 180 in the previous week and 190 in the corresponding week last year.

OFFICE FOR STONE & WEBSTER IN TACOMA.—Stone & Webster, of Boston, whose property and management interests in the far West include the Seattle Electric Company, the Puget Sound Electric Company, the Tacoma Railway & Power Company, the Puget Sound Power Company and the Whatcom County Railway & Lighting Company, all in Washington, have opened a suite of offices in the Pioneer Building, First Avenue and James Street, Tacoma, which will be in charge of Jacob Firth as resident manager. Mr. Firth now is president of the Seattle Electric Company and of the allied corporations and is also president of the Puget Sound National Bank. Mr. H. F. Grant, general manager of the Seattle Company, will have offices with Mr. Firth and will be considerably relieved of the details of the management of that property through the appointment of J. B. Lukes to the position of general superintendent of the company. Heretofore Mr. Lukes has been superintendent of lighting and power of the company.

ALLIS-CHALMERS ENGINES.—The North American Manufacturing Company, of East Liverpool, Ohio, is a recent purchaser of two Reynolds girder engines, 18 in. by 42 in., built by the Allis-Chalmers Company, Milwaukee. The Fonda Glove Lining Company, of Fonda, N. Y., recently purchased an 18-in. by 36-in. Reynolds girder engine. The Astoria Light, Heat & Power Company, of Lawrence Point, L. I., has recently purchased a Reynolds heavy-duty, cross-compound engine, 16 in. and 32 in. by 36 in. and a 32-in. by 12-in. Reynolds independent air pump and jet condenser. The George A. Fuller Company, contractor of the building of the New Plaza Hotel, New York City, has recently let contracts for the engines to be installed in the building power plant. Four Allis-Chalmers heavy-duty, cross-compound Corliss engines will be installed, two 18-in. by 42-in. and the others 22 in. by 42 in. and 25 in. by 47 in., respectively.

GAS ENGINE ORDERS.—The Allis-Chalmers Company, of Milwaukee, has been placing before the purchasing public, for some months past, its gas engines of the Nurnberg type, in capacities ranging from 300 to 5,000 hp and for all power purposes. An 1,800 brake hp Allis-Chalmers unit was recently ordered for the Crystal City, Mo., plant of the Pittsburg Plate Glass Company. It is of the well-known four-cycle, double-acting type, direct-coupled to a 1,000-kw Allis-Chalmers generator. The Illinois Steel Company, Chicago, at present using a large number of Allis-Chalmers steam units of various kinds, has very recently ordered two large gas engine generating units, twin tandem type, 1,000 kw each. These machines will be installed in the company's present power plant for lighting and power purposes.

AT THE STANLEY WORKS.—The extensive additions under way at the Stanley Works, Pittsfield, Mass., have necessitated a large increase in the power required by the company. A large cross-compound condensing engine was recently installed and the company is now erecting a thoroughly equipped boiler plant. The building will be of standard brick and steel construction throughout and is planned to provide for the installation of additional units as required. There will be four Babcock & Wilcox boilers of 340 hp each at 130 lb. pressure. They will be supplied with superheaters, Roney mechanical stokers and Green fuel economizers. The design and installation of the plant is in charge of the Westinghouse, Church, Kerr & Co.

ENLARGING POWER HOUSE.—Plans have been filed with Buildings Superintendent Murphy for the enlargement of the power station and carhouse of the New York City Street Railway Company in the block in Amsterdam Avenue, from One Hundred and Twenty-eighth Street to One Hundred and Twenty-ninth Street, which was the first street car cable power house erected in the city, and originally belonged to the old Third Avenue Railroad Company. Two stories are to be added to the building, making it a three-story and basement building, and the interior will be remodeled. The improvements are to cost $150,000, according to the estimate of A. V. Porter, the architect.

WELDING BY ELECTRICITY.—The New England Enameling Company, of Middletown, Conn., is installing new machines for welding the handles of the enamel ware into place. These will be operated by electricity supplied from the plant of the Middletown Electric Light Company. Heretofore the handles have been riveted on by hand, the process being a very slow one. It is expected that the new machines will do the work of forty hands.

ROTARIES FOR LONG ISLAND.—The Pennsylvania Railroad Company has closed a contract with the Westinghouse Electric Manufacturing Company for four rotary converters aggregating 5,000 kw capacity for use in its Long Island electric railway development work. The contract amounts to about $100,000. The machines will be duplicates of eighteen machines purchased by the Pennsylvania two years ago.

WALKER FOUNDRY COMPANY.—It is announced that the Walker Foundry Company, incorporated in New Jersey with a capital stock of $100,000, divided into 1,000 shares, will manufacture electric motors, dynamos and other electrical machinery. The incorporators are Joseph Diehl Fackenthal, John J. Daly and Albert C. Wall, all of 1 Exchange Place, Jersey City, the registered office of the concern.

WESTERN ELECTRIC FACTORIES.—The big Western Electric factories at Hawthorne, a suburb of Chicago, are to be extended this year at a cost of $1,000,000, the chief increase being in the switchboard department; but the cable plant is also to be enlarged. There will also be a lumber yard for the hardwoods that enter into switchboard construction with a capacity of four million feet.

THE NATIONAL ELECTRIC COMPANY, of Milwaukee, Wis., reports having closed a contract with the Edison Illuminating Company, of Detroit, Mich., for four 500-kw motor-generator sets, to be used for railway service.

SHAFTING.—Shafting manufacturers are to meet in Pittsburg March 26 to discuss prices and probably to advance them.

MASSENA POWER CO. SOLD.—It is announced that the Pittsburg Reduction Company, which is controlled by the Melons and other capitalists of Pittsburg, has taken over the St. Lawrence River Power Co., which owns the large water power plant at Massena, New York. The Reduction Company is the principal customer of the St. Lawrence River Power Company, which also serves five or six other industrial establishments in the same neighborhood. The Power Company has outstanding, in addition to $500,000 5 per cent. bonds, $3,500,000 of preferred stock and $3,000,000 of common stock. The company is taken over by the Pittsburg Reduction Company on the basis of an issue of $4,000,000 4 per cent. Pittsburg Reduction Company bonds in exchange for all the capital stock of the Power Company. The Reduction Company, moreover, guarantees the principal and interest of the $500,000 St. Lawrence River Power Company bonds.

NEW YORK, WESTCHESTER & BOSTON RAILWAY.—Bids will be received until March 24 by T. D. Rhodes, president of the City & County Contract Company, 30 Broad Street, New York City, for the power plant to be constructed in connection with the construction of the New York, Westchester & Boston Railway. The bids are for the construction and starting in actual operation of the following component parts of said plant: Three steam turbo-alternators with their dependent auxiliaries; twenty-four water-tube boilers with superheaters and their parts; three open exhaust feed-water heaters; six horizontal outside packed plunger boiler feed pumps; three surface condensers; twenty-four mechanical stokers; one 60-ton electric traveling crane. Information, plans, etc., may be had by applying to William A. Pratt, chief engineer, New York, Westchester & Boston Railway Company, 30 Broad Street.

AUTOMATIC REFRIGERATION.—We understand that the Automatic Refrigerating Company, of 22 Thames Street, New York, which company, it will be remembered, represents the merged interests of the Automatic Refrigerating Company, of Cleveland, Ohio; the Singer Automatic Ice Machine Company, of Bridgeport, Conn., and the Marshall Ice & Refrigerating Machine Company, of Boston, Mass., is about to remove their office, shop and refrigerating show plant to Hartford, Conn., where provision has been made for greatly increased manufacturing facilities. The Hartford address of the Automatic Refrigerating Company is to be 630 Capitol Avenue.

THE STROMBERG-CARLSON TELEPHONE MFG. CO., Rochester, N. Y. reports having closed contracts for switchboards in the following places: Holton, Kan.; Tonopah, Nev.; Nashville, Tenn.; Elkhart, Ill.; Grand Ridge, Ill.; Bryson City, N. C.; Brantford, Ont.; New York City, N. Y.; Sunset, La.; Mt. Upton, N. Y.; Carthage, Ill.; Central Square, N. Y.; Marcus, Ia.; Franklin, N. C.; Auburn, N. W.; Ladd, Ill.; Diagonal, Ia.; Lytton, Ia.; Woodstock, Ill.; Rochester, N. Y.; Seattle, Wash.; Fontana, Kan.; Clarksville, Tenn.; New Cambria, Mo.; Cambria, Mo.; Rupert, Idaho; Elkville, Ill.; Chio, Ill.

WIRING AT OGDEN, UTAH.—Mr. J. K. Taylor, supervising architect of the United States Treasury Department, notifies us that the time of opening proposals for conduit and electric wiring in the Post Office and Court House at Ogden, Utah, has been extended from March 14 to March 27.

SALE OF NATIONAL ELECTRIC PLANT.—A formal order has been entered directing the sale of the plant, real estate, patent rights and good will of the National Electric Company, of Milwaukee, at 10 a. m. March 26 in the referee's court.

## *Financial Intelligence.*

THE WEEK IN WALL STREET.—Stock prices were weak the first two days, but later on a moderate bullish tone developed with general recoveries throughout the list. There was an easier feeling as to money conditions, based on the action of the Treasury Department in coming to the relief of the market. The news from abroad indicating a more favorable termination than had been anticipated in the Morocco conference was construed as opening the way for a revival of foreign interest in the American market. The most marked concessions early in the week were in the high-priced stocks and the issues which had been under pool manipulation. In the undecided market which ensued after the decline had been checked there was little in the way of features. The steel stocks developed a fair degree of strength on the renewed stories regarding the ore land negotiations between the United States Steel Corporation and Great Northern. The copper stocks were moderately active. At the close of the week the general market was strong and buoyant in spots. Electric and traction securities were strong and firm on moderate sales. Allis-Chalmers closed at 22 for common, a net gain of 1⅝, and at 59 for preferred, a gain of 3 points. General Electric closed at the highest figure—170¼—which represents a net gain of 2½ points, and Westinghouse advanced 1 point, closing at 160½. Among the tractions, Brooklyn Rapid Transit advanced to 83⅝ from 78⅝, but lost some of the gain and closed at 82⅜, which is a net gain of 2¼ points. Metropolitan Street Railway closed at the highest figure of the week—116—and Interborough Rapid Transit (on the curb) at 229½, the latter being an advance of 1 point. Interborough-Metropolitan was quoted at 52⅝ at the close of the curb market. Little business was done in the telegraph and telephone issues, Western Union closing at 93¼ and American Telephone & Telegraph at 138. American Telegraph & Cable closed at 93, and Mackay Companies at 60. The curb market was dull during most of the week with general declines during the first day or two, followed by a slow recovery later on. There was not much public demand for stocks. Following are the closing quotations of March 13:

NEW YORK

| | Mar. 6 | Mar. 13 | | Mar. 6 | Mar. 13 |
|---|---|---|---|---|---|
| Allis-Chalmers Co. | 20⅜ | 22¼ | General Electric | 167 | 169⅛ |
| Allis.Chalmers Co. pfd. | 56 | 58⅜ | Hudson River Tel. | ... | ... |
| American Dist. Tel. | 37 | 37 | Interborough Rap. Tran. | 228⅛ | 229 |
| American Locomotive | 67¼ | 70⅜ | Mackay Cos. | 60 | 59⅛ |
| American Locomotive pfd. | 115⅛ | 116½ | Mackay Cos pfd. | 73⅜ | 74¼ |
| American Tel. & Cable | 93 | 92 | Marconi Tel. | ... | ... |
| American Tel. & Tel. | 137¾ | 138 | Metropolitan St. Ry | 115 | 115 |
| Brooklyn Rapid Transit | 79⅝ | 84⅜ | N. Y. & N. J. Tel. | ... | ... |
| Electric Boat | 27 | 27 | Western Union Tel | 93⅛ | 94¼ |
| Electric Boat pfd | 65 | 65 | Westinghouse com. | 158 | 161 |
| Electric Vehicle | 17 | 17 | Westinghouse pfd. | ... | ... |
| Electric Vehicle pfd. | 16 | 16 | | | |

BOSTON

| | Mar. 6 | Mar. 13 | | Mar. 6 | Mar. 13 |
|---|---|---|---|---|---|
| American Tel. & Tel. | 138¼ | 139 | Mass. Elec. Ry. pfd. | 67 | 69⅛ |
| Cumberland Telephone | 118½ | ... | Mexican Telephone | 4⅛ | ... |
| Edison Elec. Illum. | 246¾ | 247 | New England Telephone | 136½ | ... |
| General Electric | 167⅝ | ... | Western Tel. & Tel. | ... | ... |
| Mass. Elec. Ry. | 18⅛ | 20 | Western Tel. & Tel pfd. | 99 | ... |

PHILADELPHIA

| | Mar. 6 | Mar. 13 | | Mar. 6 | Mar. 13 |
|---|---|---|---|---|---|
| American Railways | 51 | 51¼ | Phila. Electric | 7¾ | ... |
| Elec. Co. of America | 11⅝ | 11¾ | Phila. Rapid Trans. | 30¾ | 30⅛ |
| Elec. Storage Battery | 78 | 79 | Phila. Traction | ... | ... |
| Elec. Storage Battery pfd. | ... | ... | | | |

CHICAGO

| | Mar. 6 | Mar. 13 | | Mar. 6 | Mar. 13 |
|---|---|---|---|---|---|
| Chicago City Ry | 193⅛ | 170 | National Carbon | 92 | 90 |
| Chicago Edison | 160 | ... | National Carbon pfd. | 120 | 120 |
| Chicago Subway | ... | 50 | Union Traction | ... | ... |
| Chicago Tel. Co. | 120 | .. | Union Traction pfd. | ... | ... |
| Metropolitan Elev. com. | 28 | 26⅛ | | | |

* Asked.

DIVIDENDS.—General Electric directors have declared the regular $2 quarterly dividend payable April 16. The quarterly dividend of 1½ per cent on the preferred stock of J. G. White & Co. has been declared, payable April 2. The regular 1¼ per cent quarterly dividend on the capital stock of the United Traction & Electric Company of New Jersey is payable April 2. The regular quarterly dividend of the Cumberland Telegraph & Telephone Company of 1¾ per cent is payable April 2 to stockholders. The Havana Electric Railway Company has declared an initial dividend upon its $5,000,000 non-cumulative preferred 6 per cent stock, payable April 3. Directors of the Interborough Rapid Transit Company have declared the regular quarterly dividend of 2 per cent., payable April 2 to holders of the voting trust certificates of record. Directors of the Mackay Companies have declared the regular quarterly dividend of 1 per cent on the preferred stock, payable April 2 to stockholders of record March 17. The Massachusetts Lighting Company has declared a regular quarterly dividend of 1¼ per cent, payable April 15. Directors of the Otis Elevator Company have declared the regular quarterly dividend of 1½ per cent on the preferred stock and the annual dividend of 2 per cent on the common stock. The dividends on both common and preferred are payable April 16. Directors of the Twin City Rapid Transit Company have declared the regular quarterly dividend of 1¾ per cent on the preferred stock, payable April 2. The Western Union Executive Committee has recommended the regular quarterly dividend of 1¼ per cent.

CAR CONSOLIDATION ABANDONED.—The project of merging the principal street car manufacturing companies in a $56,000,000 combination has been abandoned, according to an official statement made by Kean, Van Cortland & Co., of New York, one of the banking firms which was to have financed the consolidation. The chief difficulty is understood to have been the price asked by at least one of the companies in the proposed consolidation for its property. G. Martin Brill, of the J. G. Brill Co., was to have been the president of the consolidated organization.

# GENERAL NEWS.

## Construction News.

NORTH BIRMINGHAM, ALA.—The citizens have voted to issue $10,000 bonds for an electric light plant.

BIRMINGHAM, ALA.—A building permit has been issued to the Birmingham Railway, Light & Power Company to erect an addition to its power plant, to cost about $50,000.

PHOENIX, ARIZ.—Joseph Cox, chief electrician for the Arizona Copper Company, at Clifton, Ariz., is interested with a syndicate of capitalists in a project to utilize the waters of Black River to generate electric power for the big mining camps of Morenci and Clifton. A dam will be built across Black River, 52 miles from Clifton, and that point will be made the site for the power plant. The surveys have been completed and construction work will soon be started.

MARYSVILLE, CAL.—The franchise to construct and operate an electric railway over Eighth Street will be granted to the California Midland Railway Company by the City Council.

STOCKTON, CAL.—Newton Rutherford, city clerk, writes that the Central California Traction Company has secured a franchise for an electric railway, bids being opened February 19.

STOCKTON, CAL.—R. C. Tumelty, city engineer, writes that Prof. Cory, of Berkeley, will prepare estimates for the proposed electric light plant. The election to issue bonds for this improvement will be held later on.

WALNUT CREEK, CAL.—The officials of the Key Route System have promised to extend a branch line twelve miles in length over the hills to the proposed site of the State Farm, providing the Farm Commission will accept the site offered.

SACRAMENTO, CAL.—The Supervisors have agreed to grant a franchise to the California Traction Company for an electric railway on M Street between this city and Perkins Station, five miles from the eastern boundary of the station.

ALAMEDA, CAL.—The city trustees have decided to grant a franchise for an electric railway system, with ferry connections, provided the ordinance as introduced be first amended. W. J. Morgan and F. M. Greenwood are the parties named in the grant.

SAN FRANCISCO, CAL.—The Board of Supervisors has passed an ordinance providing for the sale on April 23 of a franchise for a telephone system to the highest bidder on the petition of the Home Telephone Company, which desires to bid for the privilege.

SAN FRANCISCO, CAL.—The Ocean Shore Railway Company, which is building a double-track electric railway from San Francisco to Santa Cruz, a distance of 81 miles, of which 10 miles is completed, is reported to have bought the Union Traction Company, of Santa Cruz, an 18-mile narrow-gauge city and suburban line.

SAN FRANCISCO, CAL.—The Board of Supervisors has formally re-adopted and re-approved the plans submitted by the city engineer for the reconstruction of the Geary Street, Park & Ocean Railroad as a city system, and upon which bids for the doing of the work are to be advertised for. Such bids, in accordance with the terms of the new resolution, are to be opened on the afternoon of Monday, April 9.

YREKA, CAL.—J. E. Turner, one of Yreka's City Trustees, has located large water rights on the Klamath River, near Keno, Ore. At the same time he located 100,000 miner's inches from the same river just over the boundary line in California. This water power will be used principally for electric power. This same water will also be diverted into a canal about 60 feet wide at top, 40 feet wide at bottom and 8 feet deep, and used for irrigation purposes.

SENECA, CAL.—Representatives of the Stanislaus Electric Power Company assumed control of the Tuolumne water system recently and are now directing its affairs. Extensive improvements will be made in the plant. The plans of the Stanislaus Electric Power Company contemplate the expenditure of $1,000,000 a year for the next two or three years, for labor alone, on its dams, flumes, ditches, etc., and a large part of this amount will be spent in Tuolumne County.

SAN FRANCISCO, CAL.—The Board of Supervisors' committee on public utilities has formally recommended the granting of the Home Telephone Company's petition for the passage of an ordinance putting up for public bidding a franchise for the establishing of a competing telephone company in San Francisco. The report of the committee was adopted by the board. The installing of the new system is to be finished within three years after it is begun, the company to have expended $4,000,000 by that time.

VISALIA, CAL.—The foundations of the building for the new steam plant to be constructed by the Mt. Whitney Power Company, just east of the city limits, are being laid and work on the building itself will be begun very shortly. The plant will have a generating capacity of 2000 hp, sufficient to produce all of the power necessary in case a break-down should occur at either of the water power plants or on any of the lines. The steam plant will be ready for operation by July. During the summer months when the water is low the plant will be used as an auxiliary.

RIVERSIDE, CAL.—The plant of the Riverside Power Company has been purchased by the Pacific Light & Power Company. It is understood that the power will be transmitted to San Bernardino and used there for lighting the city. The city was offered the plant at an annual rental of $6400, with the privilege of purchase at any time. The amount paid for power from the plant by the city amounted to $11,000. In addition, the city was offered 2000 acres of river bottom land and riparian rights appurtenant. While the city authorities were considering the question, the above deal was closed. It is understood that this land and these rights go to the Anaheim Union Water Company.

COLORADO SPRINGS, COL.—A resolution looking to the building by the city of its own gas and electric plant was introduced at a recent meeting of the Board of Aldermen, and has been taken under advisement.

BANTAM, CONN.—The Electric Light & Power Company has notified its customers that either meters must be installed or the cost of light hereafter will be 50 cents per month per lamp.

STAFFORD SPRINGS, CONN.—The Rockville Gas & Electric Company is constructing an electric light line from Rockville to Stafford Springs. When the line is finished a day and night electric light and power service will be established for both Rockville and Stafford Springs.

DOVER, DEL.—The Smyrna, Kent County & Delaware Bay Traction Company, in connection with its line from Smyrna, Del., to Woodland Beach and thence to Milford, Del., a distance of 35 miles, has decided to extend the line from Milford to Rehoboth.

WASHINGTON, D. C.—The actual work of construction has been begun on the Anacostia, Surrattsville & Brandywine Electric Railway in the District of Columbia. The road is planned to connect Anacostia, D. C., via Surrattsville, with Brandywine, Md., a distance of about 16½ miles.

ATLANTA, GA.—The Fairview Telephone Company, owning and operating telephone lines in Hamilton and Tipton Counties, has purchased the rights and property of the Atlanta Telephone Company in those places.

WASHINGTON, GA.—Engineers under direction of the Anthony Shoals Milling Company have completed the survey of Anthony Shoals in the northern part of Wilkes County, for the purpose of developing this property for electrical purposes, as proposed by J. H. and T. M. Fitzpatrick, of Washington.

STERLING, ILL.—The Green River Telephone Company is contemplating enlarging its territory and improving the service.

MORRIS, ILL.—The Gas & Electric Development Company, of Philadelphia and New York, reports the sale of the plant at Morris to Mr. Burdette L. Bowne.

DECATUR, ILL.—The McKinley syndicate has announced that interurban lines will be built this year as follows: Clinton to Bloomington, Springfield to Jacksonville, Springfield to Lincoln. The line from Decatur to Champaign depends on franchises now pending for entrance to the two cities mentioned.

CHICAGO, ILL.—The ordinance before the City Council to permit the Chicago, Milwaukee & St. Paul railroad to equip the Evanston branch from Wilson Avenue to the city limits for electrical operation is indorsed by the North Shore Improvement Associations, representing the residents of the suburbs through which the road passes.

OAKLAND CITY, IND.—A telephone franchise has been granted to Charles F. Stevens for 25 years.

COVINGTON, IND.—The Council has granted a franchise to the Fountain Warren Traction Company to construct its lines on Liberty and Second Streets.

LINTON, IND.—The City Council is considering the advisability of selling the Linton municipal lighting plant. The Linton Gas Company, of Lafayette, Ind., is said to be a bidder for the plant, and if the deal is consummated the plant will be enlarged and new machinery installed.

INDIANAPOLIS, IND.—Advocates of a new electric belt railway to encircle Indianapolis at a radius of 14 miles, held a meeting in this city March 10 and effected an organization, with B. V. Hubbard president, and T. J. Wright secretary. The proposed line will pass through 15 towns and will connect with 18 steam and electric railroads.

WABASH, IND.—Parties are here making arrangements for the building of an electric railway from this city to Warsaw by way of Urbana and North Manchester. The Fort Wayne & Wabash Valley Traction Company will furnish power for the line. It is understood that the Indiana Union Traction Company is back of the enterprise which will become a part of that great system.

INDIANAPOLIS, IND.—Charles N. Thompson, of this city, is president, and E. M. Coles, of New York, secretary of the newly organized and incorporated company capitalized at $3,000,000 to build a railroad between this city and Toledo, Ohio. President Thompson announces that arrangement has been made with the W. B. Strang Construction Company, of New York, to build the road. Steam will be used for moving freight and gasoline electric cars for passenger service.

SHENANDOAH, IA.—The Artificial Ice, Power, Heat & Light Company is contemplating the rebuilding of its electric light plant, at a cost of $25,000.

WINTERSET, IA.—At the special election held in this city February 27 the proposition to grant an exclusive franchise to the Des Moines-Winterset-Creston Railway Company, the franchise was defeated. The company will not ask another franchise, but will make use of another route which has already been surveyed, running southeast of the city and just outside the city limits.

DES MOINES, IA.—The question of granting a franchise to the Des Moines North & South Interurban Railway Company to construct interurban railways in the city of Des Moines will be submitted to the voters of the city at the regular election on March 26. It is proposed to construct, besides the street railway in the city, an interurban railway from Des Moines to Carlisle and Oskaloosa.

AMES, IA.—The purchase of the property and franchises of the Ames & College Railroad has recently been consummated by the Newton & Northwestern Railroad Company, which is building an extension from a point on its main line to Fort Dodge and another from Kelley to Des Moines, with a view to establishing electric interurban service between Fort Dodge and Des Moines. The conclusion of this deal indicates that the company intends to construct another extension from Kelley to Ames. It is also stated that this extension will later be run east to Nevada, Ia.

OBERLIN, KAN.—The citizens have voted to issue $10,000 bonds for an electric light plant.

HIGHLAND, KAN.—The Electric Company has secured a franchise for an electric light plant.

COVINGTON, KY.—The Council has adopted a resolution providing for the appointment of an engineer, to prepare plans and specifications for an electric light plant.

NORTH VASSALBORO, ME.—Agents of the Waterville & Fairfield Electric Light Company are canvassing the village for subscribers to the incandescent lights, with the intention of connecting the village by wire from Winslow should the number of lights subscribed warrant it.

SANFORD, ME.—At a meeting of the stockholders of the Atlantic Shore Line Railway was held March 2, the proposition for acquiring the property of the Portsmouth, Dover & York Street Railway Company was voted upon favorably. The capitalization of the Atlantic Shore Line will be changed and a new bond issue made, of which latter $1,900,000 will be issued at once to assist in acquiring the new property, to make immediate improvements, acquire rights of way and to begin work on a proposed new line. This new line comprises an 18-mile connecting link between Kennebunkport and York Beach and will make a continuous system of 97 miles of track, permitting direct connection between Lewiston, Me., and Boston.

WORCESTER, MASS.—It is possible that another electric light plant will be established here.

ATTLEBORO, MASS.—An appropriation of $12,000 has been voted by the Town Board for improvements in the street lighting system.

BOSTON, MASS.—The Edison Electric Illuminating Company, Boston, will start at once on a 2-story addition of brick, to cost $75,000.

FAIRHAVEN, MASS.—The lighting system in Fairhaven will be changed during the year to 3-phase, 60-cycle and a power service instituted.

WORCESTER, MASS.—A charter has been granted to the Worcester & Northern Street Railway Company, authorizing the construction of the road.

WORCESTER, MASS.—The Marlboro & Westboro Street Railway, which has been recently acquired by the Worcester Consolidated management, is to be thoroughly repaired.

TURNER'S FALLS, MASS.—It is understood that the Turner's Falls Company will build a steam plant this spring to provide for the increased demand for power during seasons of low water.

WESTMINSTER, MASS.—Municipal street lighting was decided on at the town meeting, when an appropriation was made for poles, wiring, lamps, etc. The power will be purchased from the street railway company.

TEMPLETON, MASS.—It is probable that Templeton will go into the business of municipal lighting as soon as the necessary steps can be taken to bring this about, although electrical power will be secured from the Gardner Electric Light Company instead of building a power house in Templeton.

SPRINGFIELD, MASS.—The contract for putting several miles of its electric light cables underground has been awarded by the United Electric Light Company to Fred T. Ley & Co. The amount contracted for is between two and three miles, and is located in almost every part of the city.

MARLBORO, MASS.—In about two weeks the Marlborough Electric Company will be prepared to furnish electric power to all parts of the City and Southboro. To insure continuous service the steam equipment at the station is being thoroughly overhauled and changes will be fully completed within a few days.

MANSFIELD, MASS.—The demand for more electricity for power and light has been so great that it became necessary to enlarge the city plant. The citizens at the recent election voted to expend $30,000 for the purpose. This money will be used in the purchase of another engine and in building an extension to the house.

FITCHBURG, MASS.—The directors of the Fitchburg Gas & Electric Light Company have voted to double the capacity of the electric power plant. When the new station was built provision was made for this extension. It will increase the output from 1000 kw to 2000 kw and will require the installation of another generating unit.

PEABODY, MASS.—At the last meeting of the Board of Trade, the sentiment expressed was strongly in favor of making such enlargements of the existing electric lighting plant as are necessary, and continuing the manufacture of electricity, rather than buying it from a foreign company. A report from Commissioner Wilson recommended an appropriation of $27,000 for overhauling the plant and putting in new machinery sufficient to meet the demands of the business.

ORANGE, MASS.—At a recent meeting of the directors of the Orange Electric Light Company it was decided to install two new generators and furnish a day service for power and lights; a new steam plant will also be put in at Wendell. The company has secured the loan of an arc light dynamo which will be put in at once to supply the street lamps until the new dynamos are installed when the inclosed arcs will be put in. It will be about four months before the improvements are completed.

SPRINGFIELD, MASS.—Officials of the Boston & Maine Railroad, the Hoosac Valley Street Railway Company, merchants of North Adams and men who recently purchased a large tract of lumber land in southern Vermont, have been in consultation in North Adams concerning the construction of an electric railway from the end of the Briggsville line of the Hoosac Valley Company to Hartwellville, Vt., a distance of about 10 miles. The main purpose of this line will be to furnish a means for rapid and cheap shipping of the immense amount of lumber which it is proposed to cut and ship to the market.

BOYNE CITY, MICH.—The Council is considering the proposition of W. J. Pearson to furnish the city with electric light.

PENTWATER, MICH.—It is reported that E. L. Brooke, of Hesperia, is interested in the construction of an electric railway from Grand Rapids to Pentwater.

SHEPHERD, MICH.—C. C. Field, of Shepherd, has decided to construct dams, power houses, etc., on Chippewa River, and will furnish light and power in Isabella, Gratiot, Midland and Clare Counties.

BERRIEN SPRINGS, MICH.—The Berrien Springs Water Power Company, of which F. A. Bryan is general manager, South Bend, Ind., proposes constructing a dam and power plant on St. Joseph River, to develop about 8,000 horse-power.

DETROIT, MICH.—Press reports state that the railroads of Detroit are planning to introduce the third-rail electric railway system for use in making short passenger and freight hauls in competition with the Detroit United Railway Company's lines. It is also planned to give the city a crosstown line from Milwaukee Junction to West Detroit.

TRAVERSE CITY, MICH.—Petitions for the construction of two dams on the Boardman River have been granted by the Supervisors of Grand Traverse County to the Queen City Light & Power Company. The company's petition for the privilege of setting lighting poles and stringing wires along the highway of the Traverse City and Houghton Road was also granted.

RIPPLE, MINN.—Chas. Swedback has been granted a franchise for a local telephone exchange.

FERGUS FALLS, MINN.—G. H. Gard, City Secretary, writes that there is some talk of constructing a concrete dam at the municipal electric light plant.

BIWABIK, MINN.—A movement is in progress on the range to establish an independent telephone line between range points and Duluth. Local men are interested in the enterprise.

CROOKSTON, MINN.—N. A. Hoffard, County Auditor, writes that the contract for a lighting plant for the county jail, including storage battery, has been awarded to Fairbanks, Morse & Co., of Chicago, Ill., for $3,240.

ST. LOUIS, MO.—The United Railways Company is preparing to build a new line on the Fee Fee road to connect the St. Louis, St. Charles & Western with its Creve Coeur divisions in St. Louis County.

HELENA, MONT.—The Helena Power Transmission Company has filed title to several tracts of land which will be flooded by its new dam. The transactions involve a total amount of $35,760.

BUTTE, MONT.—A petition to the Mayor and the City Council for a franchise for a new telephone and telegraph service has been filed in the office of the city clerk by Frank H. Stow, of the Home Telephone & Telegraph Company, of Portland, Ore.

LINCOLN, NEB.—The question of municipal ownership of the street railway system of Lincoln will be submitted to a vote of the people.

GIBBON, NEB.—J. H. Davis & Son will construct an electric light and power plant. They will probably do their own construction work.

RENO, NEV.—The Council has authorized N. E. Wilson, Mayor, to appoint a committee, of which he will be chairman, to investigate and report on the question of establishing a municipal electric light plant.

WADSWORTH, NEV.—The sale of the plant and the power rights of the Wadsworth Light & Power Company to the Green Hill Mining Company, which recently took over the big properties of E. Olinghouse in Olinghouse Canyon, has been consummated. N. E. Hummel, one of the attorneys who negotiated the sale, states that the Green Hill Company will at once proceed with the construction of the branch railway running from Wadsworth, where its mill is to be located, to Olinghouse.

MOUNT HOLLY, N. J.—The Burlington County Railway Company, which operates between Moorestown and Burlington, passing through Mount Holly, has applied for a franchise to extend the line toward Smithville.

ORANGE, N. J.—Only one bid was received and opened on March 5th for street lighting, that having been submitted by the United Electric Company. The bid was for $85 per light on a 5-year contract and $90 for 3 years.

SERGEANTSVILLE, N. J.—Surveys are now being made for the proposed railway between Lambertville and Flemington, which it is expected will be built. The road ultimately will be operated by electricity, but there is some question as to the motive power to be used at first.

TRENTON, N. J.—General Manager Hurley, of the Trenton Street Railway, says that the Trenton Junction extension (Trenton, Hamilton & Ewing Traction) will be constructed at once and completed by July 1 at the latest. The Mercerville and Hamilton Square extension will also be constructed at an early date.

ALBUQUERQUE, N. M.—Improvements are under way and contemplated by the Colorado Telephone Company in its local system, which will represent an outlay of about $100,000.

BURTONSVILLE, N. Y.—The Hudson River Electric Power Company of Glens Falls is considering the constructing of a dam at Burtonsville.

AMSTERDAM, N. Y.—The Empire State Power Company, of which C. M. Knight, of Amsterdam, is superintendent, has completed plans for a sub-station to be erected on Church Street, this city.

GREENPORT, N. Y.—An application of the Fisher's Island Railroad Company for permission to construct and operate a street surface railroad has been made to Commissioner of Highways George H. Fleet of Southold.

LITTLE FALLS, N. Y.—The Common Council granted on March 6 a franchise to the Hudson River Electric Power Company of Glens Falls. The company will soon commence laying conduits in the business portion of the city.

TROY, N. Y.—The Forest Park Railway Company is considering the advisability of making an application to the city of Rensselaer for a franchise to operate a street railway in that city, but nothing will be done until the matter of the franchise from this city is settled.

RICHFIELD SPRINGS, N. Y.—The interests behind the plan to build the proposed Ilion, Morris & Sidney electric railway estimate the cost of the line at $471,906 and the cost of the equipment about $159,000. The cost of the road from Morris to Sidney will be $321,230, making a total of the 56 miles fully equipped, $96[illegible]690. It is proposed to form a company with a capital of from $600,000 to $1,000,000.

BUFFALO, N. Y.—President Henry J. Pierce, of the International Railway Company, has confirmed the report that Joseph B. Mayor and William F. Sheehan have closed negotiations whereby the Traction, Gas & Electric Finance Company, recently incorporated at Albany, has secured possession of the electric light plants in Erie, Pa., and all the electric lines and franchises covering the territory between Erie, Pa., and Buffalo. The transaction involves upwards of $7,000,000.

GREENSBORO, N. C.—E. J. Justice has been granted a franchise to construct an electric railway from Greensboro to High Point.

LEXINGTON, N. C.—The city authorities are installing about $3000 worth of machinery in the municipal electric light plant, for the purpose of increasing its capacity.

ALBEMARLE, N. C.—The Albemarle Ice Company has been granted a franchise to operate electric and water plants and will establish such plants for the purpose of supplying light and water to the city.

REIDSVILLE, N. C.—A committee has been appointed to secure an engineer to estimate the cost of building an electric railway from this city to some point in Caswell County to connect with the Norfolk & Western Railroad.

GASTONIA, N. C.—The Spencer Mountain Power Company has been awarded the contract for supplying lighting current at the rate of $20 per hp-year for day use and $14 per hp-year for night use. It is estimated that about $3000 per annum will be saved by the city at these rates.

WINSTON-SALEM, N. C.—The Board of Aldermen has adopted a resolution providing for the purchase of the plant of the Winston-Salem Gas & Lighting Company, and if the same cannot be purchased at a reasonable figure, to establish a municipal gas or electric light plant.

COLUMBUS, OHIO.—The House has passed the bill appropriating $25,000 to install an electric light and power plant in the State House.

SHELBY, OHIO.—The Shelby Telephone Company has increased its capital stock from $60,000 to $75,000, and will make improvements to its exchange.

ADA, OHIO.—The Ada Telephone Company has increased its capital stock from $100,000 to $125,000. The increase is made for the purpose of providing for contemplated improvements to the system.

CLEVELAND, OHIO.—Mr. C. E. F. Ahlm, Williamson Building, this city, has been requested to prepare plans and specifications for the proposed municipal electric lighting plant for South Brooklyn, Cleveland.

CLEVELAND, OHIO.—The Cleveland, Painesville & Eastern Railway Company is negotiating for the sale of $300,000 5 per cent. bonds, the proceeds of which will provide for various improvements contemplated by the company.

TOLEDO, OHIO.—The Vulcan Iron Works are preparing to erect a new manufacturing plant consisting of eight large buildings. There will be a central power station for lighting and heating all the buildings and supplying power for the motors driving various machinery. A. Mills, a Toledo architect and engineer, is preparing the plans.

CLEVELAND, OHIO.—It is probable that the proposed Cleveland, Ashland & Mansfield Railway will be built this spring. It is being backed by the Cleveland & Southwestern interests and the engineering work is in charge of the Roberts & Abbott Company. The company will be a separate corporation with a capital stock of $1,000,000.

STEUBENVILLE, OHIO.—The Dillonvale & Ohio River Traction Company has secured a charter from the Secretary of State to construct an electric railway from Rayland to Dillonvale, a distance of 6½ miles. J. T. Hodgens is president; E. E. Erskine and T. J. Stringer, vice-presidents; W. B. Francis, secretary; W. C. Fawcett, chief engineer; Louis Lipphardt, treasurer and general manager.

CLEVELAND, OHIO.—The Baltimore & Ohio Railroad Company is preparing to install considerable electrical apparatus in the new repair shops being erected at Lorain, Ohio. There will be a very complete power plant of about 1000-hp boiler capacity and generators will be installed to furnish lighting current and to supply motors for operating machine tools and a number of devices for handling fuel and ashes. Plans are being prepared at the Baltimore offices of the company.

CINCINNATI, OHIO.—The Executive Committee of the Cincinnati & Suburban Bell Telephone Company authorized the construction of a large number of conduits, which will take every telephone wire and pole down across the canal, the cost of the new conduits will be $88,000, and the new cable to be used in them $77,000, making a total of $165,000. Bids will be called for at once. As soon as the contract is let the work will be rushed to completion. Address Bayard L. Kilgour, general manager.

MYRTLE CREEK, ORE.—C. C. White has petitioned for a franchise for an electric light plant.

McMINNVILLE, ORE.—H. S. Maloney, City Recorder, writes that the improvements contemplated to the electric light plant have not yet been decided upon.

BANDON, ORE.—The City Council has granted a twenty-year electric-light franchise to the Bandon Electric Light Company, work to be commenced by May 1.

IONE, ORE.—The City Council is holding open meetings with a view to rushing the installation of the municipal electric light plant. The money has been raised and the Council is now open for bids for furnishing material. It is intended to install a 500-light generator and to put in about 300 lamps at once.

HAWLEY, PA.—V. A. Decker, F. C. White and Lewis P. Cooke have purchased the plant of the Hawley Electric Light Company and will expend about $20,000 in improving it.

JOHNSTOWN, PA.—A syndicate of capitalists headed by C. S. Jennings, of Maryland, has obtained the charter rights and franchises of the Somerset County Electric Railway Company.

COATESVILLE, PA.—It is stated that the West Chester Street Railway Company has been granted right of way by Joseph and John Beale, between Coatesville and Gallagherville, a distance of four miles.

PHILADELPHIA, PA.—The plant of the Chester Traction Company at Penrose Ferry bridge was wrecked by the bursting of a flywheel a few days ago. It is estimated that it will cost $25,000 to repair the damage to building and equipment.

WILKESBARRE, PA.—Both the Wilkesbarre & Hazleton and the Wilkesbarre & Wyoming Valley Electric Railway Companies are preparing to make important improvements shortly. The former will extend its tracks from Ashley directly into this city.

ALTOONA, PA.—Improvement bonds in the sum of $1,200,000 will be issued to cover a mortgage for a like sum given to the Standard Trust Company, of New York, for the purpose of building the 40-mile electric railway between this city and Bedford.

PHILADELPHIA, PA.—Only one bid was received and opened on March 9 for the electric lighting contract for 1907, which was submitted by the Philadelphia Electric Company. It agreed to do the work at the same price it is getting this year, which is about $99 per lamp per year; the contract for this year amounts to $1,017,303.

PITTSBURG, PA.—Bids will be received until April 2 by Major Wm. L. Sibert, Corps Engrs., U. S. A., Pittsburg, for furnishing and erecting eight 65-hp gas engines, and eight belt-driven, 2-stage air compressors, two each of the following places on the Ohio River: Dam 2, near foot of Neville Island; Dam 3, Glenosborne; Dam 4, Legionville, and Dam 5, near Freedom, Pa., about 9, 11, 18, and 25 miles, respectively, below Pittsburg, Pa.

BELTON, S. C.—The survey for an interurban electric railway from Anderson to Belton has been completed by Engineer J. E. Sirrine, of Greenville, S. C., and the work of construction has been commenced.

CHESTER, S. C.—The Southern Power Company has made a proposition to supply the town with electricity at the rate of $20 per hp-year for not less than 2000 hp. This is about half the price being paid by the city at present and it is probable that the offer will be accepted.

HIGHMORE, S. D.—O. C. Kippenbrock, City Auditor, writes that J. L. White, of Clear Lake, has secured a franchise for water works and an electric light plant here.

YORKTOWN, TEX.—An electric light and power plant is to be installed here shortly by Koenig & Son, at a cost of $16,000.

BRYAN, TEX.—Grupe & Harold, of College Station, have decided to petition the Council for a franchise for an electric light plant.

BROWNSVILLE, TEX.—F. J. Combe and S. C. Tucker, of this city, are preparing to install an electric light and power plant here. The service will probably also be extended to Matamoros, Mex., situated opposite Brownsville.

AUSTIN, TEX.—W. F. Robinson, an attorney ot New York, has arrived at Austin for the purpose of submitting a proposition to the City Council to rebuild the dam across the Colorado River and install an electric light and power plant for the city. Mr. Robertson says he represents a strong syndicate of capitalists who stand ready to undertake and carry out the work if the city will accept the proposition.

ALEXANDRIA, VA.—It is rumored here that local promoters are endeavoring to interest New York capitalists in a proposition to construct an electric railway between Washington and Mt. Vernon, via Alexandria, in opposition to the Washington, Alexandria & Mount Vernon Railway Company. It is said that the plans call for a bond issue of $1,500,000, $500,000 to be used in the construction of eighteen miles of road and two power houses, $250,000 for the equipment in this city, $250,000 to install the line in the District of Columbia, and $75,000 for the condemnation of right of way.

TACOMA, WASH.—Application has been made by the Sunset Telephone Company for a permit to lay underground conduits in different sections of the city. If granted the work will commence at once.

SEATTLE, WASH.—E. M. Day, of Bellingham, representin~ the Seattle-Vancouver Electric Railway Company, is said to have secured for that company the old route of the Great Northern Railroad from Bellville to Bellingham, a distance of 30 miles.

SEDRO WOOLEY, WASH.—The Skagit Improvement Company has leased a tract of ground and will shortly install a 250-hp steam plant to furnish power for lighting the city. The intention is to put in an auxiliary plant for use when the present water-power plant on Gillian Creek is disabled.

MORGANTOWN, W. VA.—Secretary W. W. Smith, of the Dunkard Valley Railway Company, writes that bids for constructing the proposed railway will be received in the spring, and that the cost is estimated at $600,000.

MARINETTE, WIS.—F. H. Rosslyn, of Oshkosh, writes that the proposed power plant in which he and associates are interested, is to be constructed on High Falls, Peshtigo River, Marinette County. Engineer, Daniel W. Mead, of Chicago, Ill.

FORT D. A. RUSSELL, WYO.—Bids will be received by Capt. W. S. Scott, Q. M., U. S. A., Cheyenne, until April 14 for furnishing and installing electric light fixtures in certain buildings, and for extending the lighting system at Fort D A. Russell.

CALGARY, ALB.—The City Council is making arrangements for making improvements to the extent of $30,000 in the electric light system. Address Alderman Jones.

EDMONTON, ALB.—The City Council is considering plans for an electric railway through the city, with an extension to Kinistino. Address the mayor or city engineer, J. H. Hargreaves.

KAMLOOPS, B. C.—Extensions to the electric lighting plant are being considered by the City Council. Address Alderman McLean.

MACLEOD, CAN.—The town council is applying to the legislature for permission to build, own and operate an electric light plant. Address C. H. Baker.

CARBERRY, CAN.—The ratepayers voted almost unanimously in favor of the town building a civic electric light plant. Address Mayor Eaton.

VIRDEN, MAN.—New York parties have made a proposition to the town to install an electric light plant here. Address J. G. Rattray.

BRANDON, MAN.—C. B. McAllister, representing the Great Western Power & Machinery Company, has presented a proposition to the Council for the installation of a plant to cost $300,000. Address G. F. Sykes, secretary and treasurer.

TORREON, MEX.—More than $150,000 has been subscribed by local capitalists towards capitalizing a company for the purpose of erecting a new electric light and power plant here.

CHIHUAHUA, MEX.—Governor Enrique Creel and others of this city are interested in the project of establishing a large hydro-electric power plant on the San Pedro River, about 45 miles south of here. It is planned that electric power shall be transmitted to Chihuahua and other towns in this vicinity.

HAMILTON, ONT.—The Western Counties Power Company will build a pole line from here to Brantford, Ont., a distance of 30 miles.

BRANTFORD, ONT.—The Grand Valley Radial Company, of Brantford, has purchased the Thames Valley road running from Ingersoll to Woodstock and assumes control at once.

QUEBEC, QUE.—It is said that the North Shore Power, Railway & Navigation Company will shortly be in the market for eight 100-kw generators for the pulp mill at Seven Islands.

MONTREAL, QUE.—Senator Domville, St. Johns, N. B., cabled from England that he has interested sufficient capital for the building of the proposed electric road from Montreal to the Great Lakes, a distance of about 600 miles. The line will be known as the Canada Central.

SWIFT CURRENT, SASK.—J. T. Booker, Houston, Tex., is preparing to install a local telephone system here which will be conducted by an independent company.

## Company Elections.

MONTEREY, CAL.—At the recent annual meeting in Los Angeles of the stockholders of the Monterey County Gas & Electric Company the following officers were elected: C. W. Allen, president and general manager; Mrs. Cora E. Hubbell, vice-president; R. C. P. Smith, secretary-treasurer.

SAN FRANCISCO, CAL.—The Pacific Gas & Electric Company has elected officers for the next fiscal year as follows: President John A. Britton; vice-president, Frank G. Drum; treasurer, Cyrus Peirce; secretary, C. W. Conlisk. The board consists of N. W. Halsey, chairman; E. J. de Sabla, Jr., John Martin, Frank G. Drum, William H. Crocker, N. D. Rideout, Frank B. Anderson, Joseph S. Tobin, John A. Britton, Henry E. Bothin, Louis F. Monteagle, Garret W. McInerny, Cyrus Peirce, Carl Taylor and F. W. McCutcheon, the latter of New York City.

MATTOON, ILL.—At the meeting of the Mattoon, Shelbyville, Pana & Hillsboro Traction Company, the following officers were elected: W. R. Patton, Charleston, president; Robert Johns, Pana, vice-president; I. B. Craig, Mattoon, secreatry; J. W. Yantis, Shelbyville, treasurer.

HUNTINGBURG, IND.—At the annual meeting of the Dubois County Telephone Company the present directors were re-elected as follows: H. Landgrebe, Phil. Dilly, Chas. Moenkhaus, C. R. Ramsbrok, E. C. Dufendach, Hugo C. Rothert. The latter was also re-elected secretary.

IOWA FALLS, IA.—At the annual meeting of the Central Iowa Telephone Company the following board of directors was elected by the stockholders: Wm. Mayse, W. D. Wagoner, Jos. Husman and J. H. Huneman of La Porte, Ia.; W. V. Shipley and J. H. Funk of Iowa Falls, Geo. Wright, Chas. Hawkole, of Eagle Grove, and Otto Wettstein, of La Porte. The board elected the following officers: President, W. D. Wagoner, of La Porte; vice-president, J. H. Funk, of Iowa Falls; secretary and treasurer, W. V. Shipley, of Iowa Falls.

LOUISVILLE, KY.—At the annual meeting of the Independent Long Distance Telephone & Telegraph Company held in Wilmington, Del., in February, the following directors were elected: John A. Armstrong, J. D. Powers, Chas. J. Doherty, Donald McDonald, S. S. Adams, Jr., C. C. Bickel, J. W. Irwin, E. M. Coleman, C. L. Hughes, George W. Lewman, C. D. Knoefel, Matt O'Doherty, Ed. L. Barber.

LOUISVILLE, KY.—At the annual meeting of the stockholders of the Louisville Home Telephone Company held at Wilmington, Del., in February, the following directors were elected: John A. Armstrong, Charles J. Doherty, E. M. Coleman, C. C. Bickel, J. D. Powers, George W. Lewman, C. L. Hughes, W. C. Garland, J. G. Gray, C. D. Knoefel, Donald McDonald, Matt O'Doherty, Ed. L. Barber.

SAGINAW, MICH.—The annual meetings of the Bartlett Illuminating Company, the Saginaw Valley Traction Company and the Saginaw City Gas Company were held here recently. The Bartlett Illuminating Company directors were chosen as follows: George B. Morley, H. T. Wickes, Otto Schupp, H. D. Walbridge, S. E. Wolff. The officers are: President, H. D. Walbridge, New York; vice-president, S. Edwin Wolff; secretary-treasurer, Chas. E. Mershon; assistant secretary-treasurer, George E. Hardy, New York. The directorate of the Traction Company includes the following: George B. Morley, Thos. A. Harvey, G. M. Stark, H. T. Wickes, C. M. Clark, Philadelphia; H. D. Walbridge, New York; S. E. Wolff. The officers are: President, H. D. Walbridge; vice-president, S. E. Wolff; secretary-treasurer, Chas. E. Mershon; assistant secretary-treasurer, George E. Hardy. The Gas Company directors are the following: George B. Morley, Jas. B. Peter, T. E. Dorr; Fred H. Potter, H. D. Walbridge, T. A. Harvey, S. E. Wolff, B. C. Cobb. The officers are: President, H. D. Walbridge; vice-president, Geo. B. Morley; secretary-treasurer, Chas. E. Mershon; assistant secretary-treasurer, George E. Hardy.

COLFAX, MINN.—At a meeting of the local telephone company the following officers were elected: G. Krenz, president; Bert Hilygus, secretary; F. Henze, treasurer; B. Bouskhol and G. Poppen, directors.

ST. LOUIS, MO.—The annual meeting of the stockholders of the United Railways Company for the election of directors was held March 5. The following directors were re-elected: John I. Beggs, of Milwaukee; James Campbell, Murray Carleton, Robert McCulloch, Henry S. Priset, W. V. N. Powelson, Festus J. Wade, of St. Louis; C. W. Wetmore, George R. Sheldon, of New York. Charles H. Huttig and C. D. Smithers were elected to fill vacancies.

TOLEDO, OHIO.—The Toledo Talk-O-Phone Company has elected the following directors: George Metzger, A. L. Irish, Will Tyler, O. C. Reed, Frank Thompson, W. R. Edgar, Jacob Gerrold, Harry M. Ensign, Lawrence Lucker of Minneapolis, George Chase of San Francisco, J. C. Gurney of Cincinnati and C. O. Bevel of Pittsburg. The capital stock has been increased to $1,000,000 and the company is preparing plans to greatly enlarge the plant and add several new buildings.

SPOKANE, WASH.—At the annual meeting of the Washington Water Power Company the trustees elected were H. M. Richards, J. P. M. Richards, Thomas G. Thomson, A. B. Campbell, J. D. Sherwood, J. N. Glover, Huber Rasher, D. L. Huntington and W. A. White, Frank Lyman and George Southard, of New York. The officers elected were: H. M. Richards, president; A. B. Campbell, first vice-president; D. L. Huntington, second vice-president and general manager; H. E. Perks, treasurer, and H. L. Bleecker, secretary. The company plans several extensions and new lines during the coming year, and will greatly increase its electrical power, developed at Spokane and in Post Falls, Idaho.

# New Incorporations.

LITTLE ROCK, ARK.—Articles of incorporation have been filed by the Spring River, Ashflat & Franklin Electric Railway, Light & Power Company. The company is capitalized at $100,000. The incorporators are S. L. Guthrie, T. W. Simpson, W. O. Wadley, J. W. Bryant, R. L. Hastings, L. D. Phillis, W E. Brawley, I. G. Ritchie, R. E. Sample, J. H. Franklin, S. P. Turner, W. Clayton, C. D. Ritchie, E. C. Hotchkiss and J. N. Roberts.

SAN FRANCISCO, CAL.—The Redding & Red Bluff Railway Company has been incorporated, with a capital stock of $800,000, by L. R. Notbohm, C. G. H. MacBride, George J. Reiner, John B. Rogers and H. H. Sanborn. The company proposes to construct a railway from Red Bluff to Redding, an estimated distance of 33 miles.

LAKEPORT, CAL.—Articles of incorporation have been filed here by the Lake County Power Company, with a capitalization of $10,000,000. Lakeport will be the principal place of business of the corporation, which has been formed for the purpose of carrying on in Lake and other counties of California the generation and selling of electricity for lighting purposes, the acquisition of real and personal property and water rights, and for the manufacture and sale of ice. The directors of the new company are Wilbert T. Mariner, Herbert V. Keeling, M. S. Sayre, B. H. Henderson and A. H. Spurr, all of Lakeport.

SAN FRANCISCO, CAL.—The Coast Counties Light & Power Company has been incorporated by the California Gas & Electric Corporation interests, with a capital stock of $1,500,000. The directors are L. H. Sussman, W. J. McLean, L. W. Pryor, H. Mallock, H. Bostwick, W. B. Bosley and R. A. Morgan. These interests have been acquiring electric power and lighting plants along the cost south of San Francisco, including those in Santa Cruz and Watsonville. Negotiations have been under way for some time for the acquirement of the Monterey County Gas & Electric Company's light and power plants and electric railway at Monterey, Cal. Should this deal be consummated the new company would be able to handle all of the properties above mentioned, together with others that may be acquired in future.

VANDALIA, ILL.—The Vandalia Telephone Company has been incorporated with a capital of $6000. The incorporators are George C. Morris, Chris Bussee and Fred P. Kinder.

CHAMPAIGN, ILL.—The Madison County Light & Power Company, with a capital of $100,000, has been incorporated by Charles Zillick, B. E. Bramble and George M. Mattis.

WHITE WALNUT, ILL.—The White Walnut Telephone Company has been organized. The officers are: E. F. Logan, president; Chris. Schmalriede, secretary; Herman Pulke, treasurer.

MOUNT TABOR, ILL.—Mount Tabor Mutual Telephone Company has been incorporated with a capital of $2,500, to operate a telephone system. Incorporators are Albert Stewardson, J. W. Fleming and Levi Moorts.

VALMEYER, ILL.—An Independent telephone company has been formed at Valmeyer with the following officers: Henry Volhardt, president; E. J. Lee, Jr., secretary. The lines of the company will connect with the Farmers' Fountain Telephone Company of New Hanover.

MURPHYSBORO, ILL.—Papers have been filed asking for the incorporation of the Murphysboro & Benton Railway Company. John G. Hardy, William Wall, Charles L. Ritter, John M. Herbert and J. N. Craine are the incorporators. The capital stock is $25,000.

PEORIA, ILL.—The Peoria, Streator & Ottawa Railway Company, with principal office at Champaign, has been incorporated with a capital stock of $100,000. The incorporators and first board of directors are: W. J. Ferris, B. E. Bramble, Charles Zillick, George M. Mattis and W. B. McKinley.

HORTONVILLE, IND.—Fletcher Jessup is organizing a new telephone company.

SHIRLEY, IND.—A company has been organized here with C. W. Bouslog, president, and J. C. Wink, secretary, to construct water works and an electric light plant.

ANDREWS, IND.—The Andrews Light & Water Company has filed articles of incorporation, capitalized at $10,000. John H. Moore, W. E. Nichols and Henry B. Thornton are the directors.

INDIANAPOLIS, IND.—The Indiana Contracting Company has filed articles of incorporation with the Secretary of State. The capital stock is $50,000. The object of the company is to promote, finance and equip street and interurban railways. William C. Schoemaker, John A. Shoemaker and George P. Lyon are the incorporators.

MALLARD, IA.—The Mallard Mutual Telephone Company has been incorporated with $12,000 capital stock.

WATERLOO, IA.—The Wenkel Telephone Company has been organized vice-president.

MEDIAPOLIS, IA.—The Square Deal Mutual Telephone Company has been organized with the following officers: President, J. B. McCray; vice-president, Robert Eland; secretary, J. L. Siscoe; treasurer, Lewis Wogner.

HONEY CREEK, IA.—The Honey Creek & Southwest Telephone Company has been formed. G. W. Cronbaugh, president; Wm. Schraeder, secretary. The company will build lines from Koszta to the adjoining country.

FORT ATKINSON, IA.—The Farmers' Mutual Telephone Company, Fort Atkinson, Ia., has been incorporated with a capital stock of $2,500, President, C. D. Horton; vice-president, L. T. Huber; secretary and treasurer, J. A. Huber.

OSCAR, MINN.—The Oscar-Trondhjem Farmers' Telephone Company has been formally organized. The following directors were elected for one year: Ole K. Aaberg, president; E. Stras, vice-president; Swend Larson, secretary and treasurer, and G. T. Braatelien.

LAKE BENTON, MINN.—The Lincoln County Telephone Company has been incorporated with a capital stock of $50,000. The incorporators are K. G. Skartum, John H. Hanson, Charles E. Lavesson, Hans Lavesson, F. E. Tucker and John McKenzie, all of Lake Benton.

ST. CLOUD, MINN.—The Mississippi River Power Company has been incorporated, with a capital of $50,000, by E. F. Moore, D. H. Freeman and others of St. Cloud, to build a dam near Clearwater, manufacture electric light, heat and power, and operate a pulp and paper mill.

CORINTH, MISS.—The Corinth & Shiloh Electric Railway Company has been incorporated, with a capital stock of $250,000. Abe Rubel, president; W. J. Lamb, vice-president and manager; M. T. Bynum, secretary.

PERU, NEB.—The Peru Electric Light & Power Company has been incorporated, with a capital of $4,000, by O. N. Good, A. N. Borst and others.

TONOPAH, NEV.—Articles of incorporation have been filed by the Austin-Manhattan Telephone Company with the County Clerk of Lander County.

OKOLONA, OHIO.—The Farmers' Mutual Telephone Company has been organized by T. F. Durham, Henry Schumacher and Martin Brobst.

CINCINNATI, OHIO.—The Cincinnati Light, Heat & Power Company has been incorporated, with a capital of $100,000 by Guy W. Mallon, H. H. Bechtel and others. The company will apply for a franchise to furnish electricity for commercial use in this city.

MILLERSPORT, OHIO.—The Buckeye Lake Home Telephone Company has been incorporated with $10,000 capital stock. W. G. Palmer, W. G. Ogarag, W. R. Nutt and H. J. Brown are among the incorporators.

TOLEDO, OHIO.—The Erie Construction Company has been incorporated, with a capital of $10,000, by James E. Brailey, H. P. Yeager, A. F. Hanson, W. E. Cordill, J. C. Newton and others, of Toledo. The company will finance and construct telephone exchanges and expects to build a number of small independent plants throughout the Middle West.

BURLINGTON, OHIO.—The North Kenova Telephone Company has been incorporated by A. O'Neill, Oscar M. Elkins, Francis M. Fullerton, and others. The company proposes to establish a community exchange at Burlington.

DELTA OHIO.—The Citizens' Mutual Telephone Company has been incorporatedby William T. McQuillan, O. R. George, Claude L. Sturtevant, C. D. Eberly, Frank Terwilliger and others. The company will build an independent exchange in Delta.

GUTHRIE, OKLA.—The Kansas Union Traction Company, a Kansas company, which proposes to build an electric railway between Parsons and Coffeyville, a distance of 40 miles, has taken out an Oklahoma charter. It is capitalized at $1,000,000 and has its Oklahoma headquarters at Newkirk. The incorporators are William J. Jones and C. N. Petty, of Altamont, Kan.; S. T. Bisbee and Ralph J. Ramer, of Oklahoma City.

HARRISBURG, PA.—Newly chartered electric railway companies are the West Pittsburg & Ellwood City, with a capital of $42,000; the West Pittsburg Electric Railway Company, with a capital of $6000; and the Crescent Avenue Electric Railway Company, having a capital of $6000. The presidents of these companies are C. P. Dushane, E. G. Dunham and Frank S. Hoyt, respectively. The first company contemplates building about 7 miles of line and the other two will construct one mile of road each.

WHITE LAKE, S. D.—The Northwestern Telephone Company has filed articles of incorporation, with a capital stock of $3,000. L. G. Sale, J. E. Ellis and Charles Gobler are the incorporators.

ETHAN, S. D.—The Ethan Telephone Company has been incorporated, with a capital stock of $1,500, by J. A. Howard, W. G. Snyder, Philip Germscheid, Joseph Friedel, and others, all of Ethan.

HERMOSA, S. D.—The Hermosa Telephone Company has been incorporated, with a capital of $10,000. S. M. Booth is president; H. C. Closson, vice-president; Paul D. McClelland, secretary; Edward Stenger, treasurer, all of Hermosa.

NOBLE, .TEX.—The South Canadian Telephone Company has been incorporated with a capital of $1000, by C. M. Hebaugh and others.

TARPLEY, TEX.—A. M. Stigler and J. O. Bintner have filed articles of incorporation for the Bandera Telephone Company, with a capital of $4000.

HUBBARD, TEX.—The Hubbard Light & Power Company has been incorporated, with a capital of $10,000, by Wm. Burr, J. N. DuBois and W. A. Atkinson, of Dallas.

PECKHAM, TEX.—The Peckham & Northwestern Mutual Telephone Company, with a capital stock of $4000, has been incorporated by B. H. Fisher, J. W. Stewart and others.

THOMAS, TEX.—The Home Telephone Company has filed articles of incorporation, having a capital stock of $20,000. J. F. Gully, W. L. McClung and A. H. Donnell are among the incorporators.

EMPIRE, WIS.—The Empire Telephone Company has been incorporated by William C. Ray, H. Keys and H. D. Vinton. The capital is $1800.

WONEWOC, WIS.—The Wisconsin Home Telephone Company has filed articles of incorporation, with a capital of $25,000. The incorporators are A. E. Hazlik, M. E. Hutchins and F. A. Serrurier.

OSCEOLA, WIS.—Farmers and business men of this city have organized a new telephone company and articles of incorporation have been filed with the Secretary of State. The directors are: George A. Taylor, president; Geo. F. Clark, vice-president; Charles H. Oakley, treasurer.

MEDICINE HAT, ALB.—The Alberta Southeastern Telephone Company has been formed here with the following directors: W. C. Harris, S. T. Fawcett, William Rutherford, George Henry and W. Nicholls. Sufficient subscribers have been obtained to build a line to Cypress Hills, a distance of 50 miles, and construction will be commenced at once.

VANCOUVER, B. C.—The Vancouver, Fraser Valley & Southern Railroad Company has been incorporated to build an electric railway from Vancouver to Blaine, Wash., via New Westminster, also through the Fraser Valley to Chilliwac and Delta municipalities.

VANCOUVER, B. C.—The Burrard Power Company, Ltd., has been organized to develop the water power of Lilloeb Lakes and tributaries, for the purpose of generating electricity for light, heat, manufacturing and industrial purposs. The power plant will probably be located on Fraser River, in the vicinity of Port Haney.

CARTWRIGHT, MAN.—The Mather Co-operative Telephone Company has been formed here with the following officers: President, T. E. Elliott; vice-president, H. McLean; secretary-treasurer, D. B. McKinnon; trustees, Joseph Bere, George Mayo, James Melvin, John Burrows, D. Fulford.

## New Industrial Companies.

THE VIRDEN ELECTRIC COMPANY, Virden, Okla., has filed articles of incorporation, with a capital of $10,000. The incorporators are Samuel Black, of Leal; E. C. Englehart, of Virden, and Roy Black, of Minco.

TYPEWRITING TELEGRAPH COMPANY, New York, N. Y., has been incorporated with a capital of $250,000. The directors are W. W. Crehore, Elizabeth, N. J.; W. C. Sherwood, Jersey City, and A. F. Garbe, of New York.

THE NILES ELECTRICAL CONSTRUCTION COMPANY, of Niles, Ohio, has been incorporated. The company is capitalized at $10,000 and will do electrical repair and construction work. Among those interested are W. M. Kerr, William Stephens, Edward Lyon and H. Wilson.

THE CAMDEN & ATLANTIC AUTOMOBILE COMPANY, of Camden, N. J., has been incorporated with a capital of $25,000. The company will manufacture, buy and sell automobiles and will also operate automobiles between Camden and Atlantic City for the purpose of carrying passengers and freight.

THE THOMPSON ELECTRICAL COMPANY, of Evansville, Ind., has been incorporated to do a general electrical supply and construction business. The new firm will open a factory and supply house at 329 Upper Third Street. J. E. Thompson and Henry Koehler are among those interested in the concern.

THE WALKER FOUNDRY COMPANY has been incorporated in New Jersey with a capital stock of $100,000, to manufacture electric motors, dynamos and other electrical machinery. The incorporators are Joseph Diehl Fackenthal, John J. Daly and Albert C. Wall, all of 1 Exchange Place, Jersey City, the registered office of the concern.

## Legal.

LARGE INJURY AWARD.—At Syracuse, N. Y., on February 24, the jury in the case of Florence Ryan against the Central New York Telephone & Telegraph Company returned a verdict of $20,000 for the plaintiff. Miss Ryan is nineteen years old. She fell in a trench dug for the subway of the telephone company and for eight months lay in a state of coma. The defence alleged that her condition was due to hysteria as the result of suggestion.

ST. CLAIR, MICH., INJUNCTION.—The citizens of this city have manifested their opposition to the installation of a system to secure electric power from the St. Clair water works and current for lighting purposes from a Port Huron concern, by the commencement of an injunction suit in the Circuit Court to restrain the mayor, F. W. Moore and city clerk, W. H. Brown, from carrying out the contract. It is claimed that it will cost the city $10,000 for the necessary machinery and will wrongfully divert money voted for the purpose of obtaining new municipal electrical equipment.

CHICAGO DRAINAGE CANAL.—The famous case of the State of Missouri vs. the State of Illinois involving the right of the City of Chicago to divert its sewage into the Mississippi River through the Chicago sanitary canal and the Illinois River has just been decided by the Supreme Court of the United States in favor of Illinois. This decision leaves the way clear for the power development project which is well in hand for using the 40,000 hp in water power at Lockport, Ill., the lower end of the Sanitary and Ship Canal. At this point will be installed four 4000-kw, three-phase, 60-cycle, 6600-volt alternating-current generators now nnder construction in the shops of the Crocker-Wheeler Company, Ampere, N. J.

LIGHTING IN BAY CITY.—The suit of the Bay City Traction & Electric Company of Bay City, Mich., against the city to determine the right of the city to engage in commercial lighting on the east side of the river has been filed in the Circuit Court. The company asserts that it is impelled in its action by the fact that as a taxpayer it is entitled to rights possessed by anyone else, and that aside from any injustice to its business the city has no authority to engage in further commercial lighting. The company says that it is not subject to taxes for improper purposes, the explanation being that if the city spent money for commercial lighting it would do so by incurring indebtedness for the cost thereof, and as the action would be improper the consequent taxation would be improper.

WIRELESS LITIGATION.—The Gesellschaft fur Drahtlose Telepraphie of Berlin writes us as follows as to recent litigation in this country on the Fessenden liquid barretter: "In reference to your article in No. 5 of February 3, 1906, page 302 under "Legal," and headed "Fessenden Liquid Barretter," we beg respectfully to bring the following to your notice: The article in question appears to us to be somewhat indistinct. The writer appears entirely to overlook the fact that, firstly, a temporary injunction only has been issued and this merely as regards specific claims. It would, however, appear from the item that our company were forbidden to manufacture, use or sell in the U. S., any apparatus whatsoever on the "System Telefunken," a system, to use the words of your English contemporary, of great prominence and world-wide reputation, whereas the injunction on the basis of an opinion by Judge Wheeler, refers only to claims 11, 23 and 25 of Mr. Fessenden's patent No. 12,115, the said claim covering only a cell with an extremely fine terminal, i. e., a terminal with a diameter of less than 0.0004 of an inch. In conclusion we beg particularly again to emphasize the point that the action is not yet definitely decided."

RATES AT LOS ANGELES, CAL.—For failure and refusal to comply with a city law, seven of the representative officials of the Home Telephone & Telegraph Company have been arrested with a view to testing the validity of this law. They are J. M. C. Marble, president; A. B. Cass, vice-president; J. H. Torrance, secretary; H. W. Hellman, treasurer, and W C. Patterson, W. S. Bartlett and Thomas W. Phillips, directors. The complaint was issued under the penalty clause of an ordinance which measure provides for the fixing and regulating by the City Council of rates to be charged for telephone and light service. To enable the council to fix the charges advisedly, the ordinance provides that the various public service companies shall during the month of January of each year file reports of receipts and expenditures and valuation of their respective properties. With this ordinance the Home Telephone & Telegraph Company refuses to comply, and the attention of the district attorney was directed to the case. The penalty clause of the ordinance provides that "any person, firm or corporation violating any of the provisions of this ordinance shall be deemed guilty of a misdemeanor, and upon conviction theref shall be punished by a fine not exceeding $500, or by imprisonment in the city jail for a period not exceeding 100 days, or by both fine and imprisonment."

PAYMENT FOR PAVING.—A decision holding that the city of Trenton, N. J., has an action against the Trenton Street Railway Company to compel that company to pay its share of the cost of paving South Broad Street, North Broad Street and East State Street, has been given in the Supreme Court by Chief Justice Gummere. This decision is in the case which was instituted by the city through city solicitor Charles E. Bird, and in which the city seeks to recover from the Trenton Street Railway Company about $40,000 of the cost of repaving the streets named above. When the Trenton Street Railway Company changed its motive power from horses to electricity, the city of Trenton gave it permission to place electric tracks, to string wires and to erect poles, and in return for this privilege the company was to pay for the paving of streets occupied by its tracks for the distance inside the rails and for a specified distance beyond the outer rails. The ordinance granting the franchise and providing that the company should pay for its share of the paving was accepted in writing. The question raised in the suit was whether the ordinance and the acceptance of it in writing constituted a valid contract. The Supreme Court holds that the contract is valid and that because of the refusal of the company to perform its part of the contract the city has an action for damages.

## Educational.

UNIVERSITY OF WISCONSIN.—The College of Engineering of the University of Wisconsin has just received a Curtis steam turbine which is being installed in the mechanical laboratory of the engineering building. The new machine, which is in part the gift of the General Electric Co., will be used for the instruction of students and for experimental work. It is of 35-hp capacity. Owing to the increasing importance of this kind of machine in electrical plants, as well as its successful application recently for ship propulsion, the college of engineering considers itself very fortunate in securing this valuable addition to its laboratory equipment.

# Personal.

MR. C. M. CALDWELL has been appointed City Electrician of Kansas City, Mo., to succeed J. A. Burns.

MR. LELIO BORNO has assumed the direction of the telephone service of Port au Prince, the capital of the Island of Hayti, West Indies.

MR. ALBERT SPIES has retired from the editorship of the *Electrical Age*, with the completion of the February issue. He will continue in editorial charge of *Cassier's Magazine*.

MR. WARREN D. KING, manager of the municipal electric light plant, of Peabody, Mass., has been elected a member of the executive committee of the Municipal Light Association.

MR. ALBERT UHL has severed his connection with the firm of Uhl & Elliott, electrical engineers and contractors of Shreveport, La., and has joined the staff of the Woods Electric Company, of Houston, Tex.

MR. HARRY G. McCULLY, superintendent of the New Jersey division of the New York & New Jersey Telephone Company, on March 1 retired from that position to assume other duties in the service of the same company.

MR. EUGENE W. GODFREY, of Boston, Mass., has been engaged as general superintendent for the Marlboro Electric Light Company, to succeed Herbert E. Ryder, who resigned recently to accept a similar position at Fall River.

MR. CLAUDE L. CLARY, who has been connected with the sales department of the Western Electric Company, has resigned to accept the general management of the Sikeston Ice, Light & Power Company at Sikeston, Missouri.

MR. WESLEY WENTWORTH has been appointed general manager of the Houston Electric Company, of Houston, Tex. Mr. Wentworth comes from Dallas, where for the last nine months he has been superintendent of the Dallas Consolidated Street Railway Company.

MR. LELAND HUME has been promoted from the office of assistant general manager to that of general manager of the Cumberland Telephone Company, Nashville, Tenn. Mr. Hume was also elected president of the Nashville Board of Trade.

MR. C. L. KNIGHT, who for a number of years has been superintendent of the Sacramento Electric, Gas & Railway Company's power plant at Folsom, Cal., has been transferred to a position with the California Gas & Electric Corporation at Alta. F. O. Hutton of Sacramento will succeed Mr. Knight as superintendent of the Folsom plant.

MR. FRANK H. BETHEL, who has been associated with the Chesapeake & Potomac Telephone Company as its general manager since May 1, 1904, has been appointed vice-president of that company as well as vice-president of the Bell Telephone Company and of the Delaware & Atlantic Telephone Company.

MR. G. A. DURKEE, who for the past year has been chief engineer at the municipal electric light plant of Clifton Springs, N. Y., has been advanced to the position of superintendent of the electric lighting system to succeed Mr. A. J. Short, who expects to take a position in the northern part of the State in the near future.

MR. F. B. HUNTINGTON, vice-president and secretary of the Fond du Lac Street Railway & Light Company, the Fond du Lac & Oshkosh Street Railway Company, and the Eastern Wisconsin Street Railway & Light Company, of Fond du Lac., Wis., has resigned from these companies to become comptroller of the Chicago Terminal & Transfer Company.

MR. HORACE E. ANDREWS, president of the Cleveland Electric Railway Company, will sail on March 10 for a two months' automobile trip through Europe. Mr. Andrews will pay some attention to the street and interurban railway situation in Europe and will inspect the subway in London built by the late Charles T. Yerkes.

MR. E. J. BEARD.—Mr. E. J. Beard, chief assistant engineer of the Chicago, Rock Island & Pacific Railway, will resign to become engineer of steam railways in the Philippines with J. G. White & Co. He will have complete charge of the $11,000,000 work which that company has undertaken. The construction corps will be organized in New York in the near future.

MR. FRANK B. GREENWOOD has been appointed superintendent of the Home Lighting, Power & Heating Company of Springfield, Ohio, to fill the vacancy caused by the resignation of W. N. Zurfluh, who has resigned. Mr. Greenwood has recently been chief inspector of the Central Union Telephone Company at Springfield, but was formerly in central station work.

COL. F. S. DICKSON, of Cleveland, Ohio, has announced his intention to resign the presidency of the various Federal telephone properties, and of his acceptance of the management of the local offices of A. O. Brown & Co. Mr. Dickson's successor has not been announced and he will remain at the head of the various companies until such time as he can be relieved.

MR. A. E. WINCHESTER, superintendent of the municipal electric light plant at South Norwalk, Conn., has been granted leave of absence by the City Council to enable him as member of the special committee of the National Civic Federation on municipal ownership to visit Europe and inspect several of the plants there. He sails on the Cunarder "Lucania" on March 17 for London to join the other members of the special commission, whose work is expected to last until August 1.

MR. LEE H. NEWBERT, manager of the Marysville Gas & Electric Company, Marysville, Cal., has been appointed to the position of superintendent of the Peninsular Division of the California Gas & Electric Corporation. He will enter upon his new duties about March 10. The Peninsular Division is that territory between San Bruno or South San Francisco and the town of Lawrence, near Santa Clara. It embraces San Mateo, Redwood City, Palo Alto, and a number of smaller places. Mr. Newbert will reside at San Mateo.

MR. DANA PIERCE has been engaged by the Underwriters' Laboratories as engineer in charge of electrical work. He begins his duties this month, spending a few days at the New York office of the Laboratories, going to Pittsburg to attend the annual conference between experts in the employ of insurance interests and those of the Westinghouse Companies, and takes up his active duties at the executive offices and testing station of the Laboratories in Chicago about the 15th. Mr. Pierce graduated from Amherst College with the class of 1892, and since that time has devoted himself to physical laboratory practice and electrical engineering, taking a post-graduate course at Johns Hopkins, and afterwards doing a variety of work at Harvard and Cornell laboratories, conducting experiments in high-tension electrical measurements at Worcester Polytechnic Institute and acting as instructor in laboratory work at Pratt Institute.

# Trade Publications.

LUBRICATING OILS.—A catalogue recently received from the A. W. Harris Oil Company, Providence, R. I., deals with lubricating oils for general engineering work and for all special conditions and requirements.

F. T. PAISTE COMPANY, Philadelphia, Pa., has issued for February a folder, Bulletin No. 29, illustrated, and devoted to its latest types of fusible hanger boards, taplets, panel cut-outs, entrance switches, and panel-boxes. The last page has a racy talk on "Holoshades."

AMERICAN ELECTRICAL WORKS, Phillipsdale, R. I., have issued under date of February 15 a price schedule, in envelope form and size for bare copper wire, office and annunciator wire, and weatherproof iron wire. It includes also a freight schedule for car loads and less.

GASOLINE ENGINES.—The R. M. Cornwell Company, Syracuse, N. Y., has issued an illustrated booklet describing the Wonder gasoline engines. These engines are of the two-cycle type and are characterized by simplicity of design and operation. The outfits are compact and very light.

WIRE & TELEPHONE COMPANY OF AMERICA has issued a very neat binder in lavender cloth, quarto, for its trade literature. Bulletin 100 is the "Foreword" and is devoted to general matters on its bare and insulated wire, telephone apparatus and telephone supplies. Later bulletins will take up these and other subjects in detail.

STEAM ENGINES.—Bulletin No. 17 of the Ridgway Dynamo & Engine Company, Ridgway, Penn., describes and illustrates McEwen engines of the simple and of the tandem compound types. The illustrations represent the various constructional features of the engines and show belted-type engines, and engines direct connected to Thompson-Ryan dynamos.

TOLL TELEPHONES.—The Gray Telephone Pay Station Company, Hartford, Conn., has issued a well illustrated catalogue dealing with toll equipments for public and measured telephone service, and describing specifically Gray public pay stations for the automatic collection of telephone charges and Gray registers for measured service on private or party line.

FIRE PUMPS.—A neatly executed publication describing pumps for fire service has recently been issued by the Goulds Manufacturing Company, Seneca Falls, N. Y. An interesting description is given of the high-pressure fire protection plant installed at Coney Island, New York. In the pumping station there are three triple-acting pumps, direct-connected to three Nash vertical three-cylinder gas engines.

VARIABLE-SPEED MOTORS.—The Electro-Dynamic Company, Bayonne, N. J., has issued circular No. 23, dealing with inter-pole motors of the open and semi-enclosed types. A view is given of a motor with extended shaft and without feet, which is adapted for electric hoist or crane work, where it is desired to set the motor in a shell or cradle. Circular No. 22 of the same company points out in a convincing manner the advantageous features of the inter-pole construction.

WARD LEONARD ELECTRIC COMPANY, Bronxville, N. Y., has issued a catalogue No. 1906*2*, covering Ward Leonard motor starters equipped with 20 steps of resistance for speed control by field regulation. The catalogue includes cuts, diagrams of connections showing internal connections, descriptions, prices, etc., covering both the plain no-voltage release type and the interlocking overload circuit breaker and no-voltage release type. This catalogue will be sent upon request.

TELEPHONES.—Bulletin No. 38 of the Sumter Telephone Manufacturing Company describes in detail the Mason multi-discharge lightning arrester in which the grounding medium is completely encircled by the conductor and exposed to it four times within each convolution, thus securing a multiplicity of discharge points and an effective dissipation of the lightning. Bulletin No. 39 of the same company contains 44 pages dealing with "New Benty" telephones and accessories.

HOLOPHANE LITERATURE.—The Holophane Glass Company, 227-9 Fulton Street, New York City, has just issued two handsome pamphlets, one entitled "Lighting of Churches, Schools, Libraries and Hospitals," and the other "The Lighting of Theatres and Public Halls." Both are illustrated, and with the aid of the descriptive text, an excellent idea is afforded of the manner in which the Holophane prism globes have been able to improve to a remarkable degree the illumination of these places of public resort.

CIRCUIT BREAKERS.—The Ward Leonard Electric Company has issued a new catalogue covering circuit breakers, catalogue No. 19061. This catalogue differs from the last circuit-breaker catalogue, No. 19043, in that the "DKE" type no-voltage and overload and the "PEL" type no-voltage release circuit breakers are described and listed. Both of these circuit breakers are catalogued for use in the protection of motors. The no-voltage and overload circuit breaker is a single pole breaker, which cannot be closed upon short circuit or overload.

THE POWER AND MINING MACHINERY COMPANY, Cudah-- Wis. (suburb of Milwaukee), will shortly have off the press the following publication, Catalogue No. 4, Rock-Crushing Plants. This is the second edition of the P. & M. M. Co.'s Catalogue No. 4. All of the matter contained in the first edition has been thoroughly revised to conform with the latest and best engineering practice. This catalogue will contain 72 pages, fully illustrated, and will be sent upon request to those interested in modern crushing plants and equipments.

STEAM ENGINES.—The 1906 catalogue of the Harrisburg Foundry & Machine Works, Harrisburg, Pa., contains a well prepared description of Fleming engines. Illustrations are given of simple engines for direct connection to electric generators and for belt driving; also of side-crank tandem compound engines, of the self-lubricating four-valve Corliss engines of the simple and compound types and the long-stroke Corliss engines; while mention is made of the fact that the company is prepared to construct the "Fleming" steam turbine.

MATTHEWS CATALOGUE.—The new catalogue of the W. N. Matthews & Brother, 227 North Second Street, St. Louis, is a handsome piece of work, containing 32 pages of text descriptive of the Stombaugh guy anchor and the Kearney cable clamp, and illustrated by numerous half-tones. The cover is richly and tastefully printed in three colors. This catalogue should prove very interesting and valuable to electric light, telephone, telegraph and street railway companies, as it embodies much useful data as to the construction of pole lines. A copy will be mailed on request.

SOME ROEBLING PRODUCTS is the suggestive title of a pamphlet, oblong form, envelope size, 36 pages and cover, issued by John A. Roebling's Sons Co., Trenton, N. J. It shows the cable bridges across the East River, New York; the tall buildings with wire rope for their elevators, cup winners with wire rigging; tugs with wire hawsers, wire rope transmission cables, the electric power cables of 4427 feet span across the Cargainez Straits, wire rope fastenings, alligator wrenches, steel core bell cord, double galvanized telephone wire, copper telephone wire, coppr trolley wire and insulated wires.

STATIONARY TRANSFORMERS.—Bulletin No. D of the Electrical Manufacturing Company, Lafayette, Ind., is a neat publication dealing at length and in detail with the constructional features and operating characteristics of Hornberger. An interesting and instructive feature of the bulletin is a table showing the general and the electrical charactristics of a complete line of 60-cycle transformers. This table gives the weight of coils, weight of core, weight of case, weight of oil, total external surface, maximum temperature rise, core loss, copper loss, regulation and efficiency. These transformers have been designed for exceptionally high efficiency, and low temperature rise. The bulletin closes with the statement that "Quality is remembered long after price is forgotten."

THE SPRAGUE ELECTRIC COMPANY, New York, is sending out a unique and forcible advertisement emphasizing the idea that the popularity of the electric drive is largely due to the perfection of design and construction of that company's round type motor. The card shows a supposed niche in the Hall of Fame containing a round type motor, and the tablet underneath bears this inscription: "The Motor that Made the Electric Drive Popular." That the round type motor was one of the most prominently successful among the earliest electric motors is a fact generally known to those familiar with electrical progress, and the care uniformly exercised in the design and manufacture of these motors has greatly extended their use and firmly established their popularity in the field of mechanical drive.

## News of the Trade.

THE UNION TWIST DRILL COMPANY, of Athol, Mass., is installing an electric power plant, which will have sufficient capacity to run the present plant with its recently completed addition and an addition which it is proposed to make this spring. The plant is now run by steam and water power, which will be discarded. The General Electric Company is installing the new equipment.

THE AMERICAN ENDOSCOPIC COMPANY, Providence, R. I., manufacturer of miniature lamps, pocket flash lights and other electrical specialties, has found its old plant entirely inadequate for its rapidly increasing business and has consequently been compelled to seek larger quarters. It is now located at 23 to 33 Broad Street in that city, where it has one of the most completely equipped plants in the country for turning out its line of specialties.

THE BROWN HOISTING MACHINERY COMPANY, of Cleveland, Ohio, is erecting a large electrically-operated ore-handling outfit at Toledo for the Toledo & Ohio Central Railroad. It consists of three legs of fast clam-shell plants each capable of unloading about 200 tons of ore an hour. Each leg is operated by two 235-hp motors. Two larger motors drive the entire plant, and it has a travel of about 700 feet. The outfit will have a capacity of unloading the largest vessels on the lakes in 18 hours.

THE BULLOCK ELECTRIC MANUFACTURING COMPANY, of Cincinnati, O., has just placed an order with the Electric Cable Company, 42 Broadway, New York, for the new insulating compound, Voltax, for impregnating field and armature coils. This material, which is rapidly being adopted by many of the large railway and manufacturing companies, has only recently been placed on the general market. It is cheaper than rubber insulation and with the increase in the price of pure rubber this new material is coming into very general use. The tests which have recently been made of this compound by the Electrical Testing Laboratories of New York have shown that Voltax possesses all of the insulating properties of rubber and in many cases has withstood tests far more severe than rubber. As Voltax has no injurious effects upon copper it does not require thinning before applying the compound, as there is no corrosive action whatever. Further, it is not subject to chemical change. Tests have also proven that Voltax wire and cables can be handled at all temperatures and the insulation will not crack or harden at 20 degrees Fah.

# Weekly Record of Electrical Patents.

UNITED STATES PATENTS ISSUED MARCH 6, 1906.

[Conducted by Rosenbaum & Stockbridge, Pat. Attys., 140 Nassau St., N. Y.]

814,021. RAILWAY TRAFFIC CONTROLLING APPARATUS; Clarence W. Coleman, Westfield, N. J. App. filed Apr. 13, 1905. In order to avoid variable and indefinite movements of the semaphore arm by reason of expansion, loose joints, etc., in the connection rods, the patentee operates a fluid compression device by the rod connection, and utilizes the compressed fluid to move the semaphore arm.

814,049. METHOD OF TREATING MATTE; Woolsey M. Johnson, Hartford, Conn. App. filed May 27, 1903. The method of treating material containing nickel and copper sulphides, which consists in roasting the same, dissolving the roasted residue in sulphuric acid, electrolizing the solution with suitable anodes, while passing into the electrolyte the gases derived from the roasting operation, and returning the acid electrolyte to the roasted material.

814,050. ELECTRICAL SMELTING PROCESS; Woolsey M. Johnson, Iola, Kan. App. filed May 24, 1904. A smelting process which consists in interposing between a charge containing low grade ore and a furnace wall, a charge containing high-grade ore, thereby protecting said wall from the action of the low-grade ore.

814,064. STORAGE BATTERY; Francois Mouterde, Lyon, France. App. filed July 24, 1905. A storage battery comprising a lead vessel having columns integral with its bottom and provided with flanges, a plurality of other electrodes disposed in the vessel, and a spider supporting said electrodes and terminating in a central pole, and said electrodes and said vessel being provided with Y-shaped projections adapted to receive lead fibers between them.

814,075. TROLLEY CATCHER; Simeon F. Pierce, St. Paul, Minn. App. filed June 5, 1905. A fluid pressure retrieving cylinder is connected to the trolley pole, and has a piston valve which is moved to admit air to the cylinder in case of a sudden compression therein, as when the pole moves upward in leaving the wire. The admission of air serves to depress a piston and retrieve the pole.

814,083. GENERATOR OF INTERMITTENT ELECTRIC CURRENTS; Malcolm P. Ryder, White Plains, N. Y. App. filed Aug. 12, 1904. A permanent magnet has soft iron pole pieces upon which are wound bobbins forming part of the generator circuit. Two soft iron armatures are arranged to complete the magnetic circuit, either through or outside the bobbins so that a sudden e.m.f. is generated as the charge is made.

814,118. TELEPHONE SYSTEM; William W. Dean, Chicago, Ill. App. filed June 15, 1903. In combination with a telephone line, a line signaling device therefor, a testing plug, suitable connections from said plug and a suitable source of current to test the condition of the line signalling device when desired, and an operator's outfit connected with said plug whereby the said plug may be used for conversational purposes when desired.

814,123. ATOMATIC FIRE ALARM; Napoleon H. Ferland, Manchester, N. H. App. filed June 3, 1905. Patentee provides two contacts which are spring pressed toward one another but normally held apart by a strip of celluloid. The mechanism is contained in a box having a celluloid window and in case of fire the celluloid window and strip are consumed so as to give the alarm.

814,146. PANEL BOARD; Ernest R. Le Manquais, New York, N. Y. App. filed June 9, 1904. Secured to the marble panel board by the same bolt connections are two metallic clips or fixtures, one of which constitutes a rigid fork to receive the end of the fuse tube and the other a spring clip to establish electrical connection therewith.

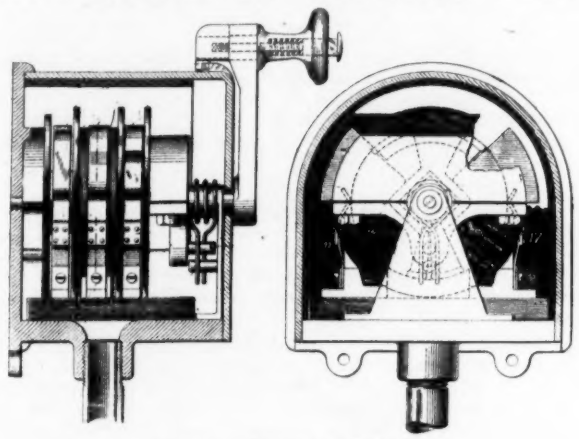
814,155. APPARATUS FOR DECOMPOSING WATER BY ELECTROLYSIS; William T. M. McCarty, Rocky Ridge, Md. App. filed Nov. 8, 1904. In combination with a tank, a partition mounted therein and dividing the tank into two chambers, said partition being provided with a line of apertures, and an electrode mounted in each compartment and connected with a suitable source of current supply and having a terminal discharge portion extending at right angles to the body of the electrode located opposite and in line with all the apertures in said partition.

814,162. ELECTRIC INCANDESCENT LAMP; William J. Phelps, Detroit, Mich. App. filed Dec. 22, 1902. A form of Hylo lamp in which the long and short filaments are connected in series between the shell and stud of the lamp. When the lamp is screwed firmly into its socket, however, an additional contact is made which cuts out the short filament.

814,217. CONDUIT OR CASING FOR ELECTRICAL CONDUCTORS; Richard H. W. Knight and Ludwig Nagel, London, Eng. App. filed Mar. 1, 1904. Sheet metal strips of C-shaped section are capable of being nested together in pairs so as to form a complete tube. Elbows and T's of corresponding construction are also provided.

814,219. AUTOMATIC TELEPHONIC INSTALLATION; Bernhard Kugelmann, Bad Kissingen, Germany. App. filed Sept. 15, 1903. In an automatic telephone system, the combination with the lines of the subscribers, of a number of switch apparatuses, each including one common speaking way, and a series of relay devices, one of such devices in each series being attached to each subscriber's line for control by the subscriber, each relay device adapted to join the corresponding line of the subscriber to the said common speaking way, and each apparatus when occupied bringing the next unoccupied switch apparatus into the sphere of control of the subscribers.

814,259. RECIPROCATING ELECTRIC MACHINE; Truman H. Aldrich, Birmingham, Ala. App. filed Apr. 5, 1905. A hollow wire



814,324.—Controller Switch.

coil or bobbin is slidably supported on a rod which constitutes the pole of a pair of opposed iron clad magnets. Connections are provided for reversing the polarity at the limit of forward and back movement of the movable coil.

814,277. SWITCH KEY; Edward B. Craft, Chicago, Ill. App. filed Dec. 7, 1904. Relates to specific details of switch key for telephonic exchange switchboards.

814,302. ELECTRICAL SIGNAL SYSTEM; Fred Lacroix, San Antonio, Tex. App. filed Aug. 29, 1904. The track is divided into sections and one rail is continuously energized to a fixed potential throughout its length. The other rail is connected to a return wire through resistances of varying magnitude. The purpose is to have the strength of current in the return wire indicate the position of the train along the track.

814,303. ELECTRICAL SIGNAL SYSTEM; Fred Lacroix, San Antonio, Tex. App. filed Jan. 31, 1905. Relates to additional features of the above. In this case a special trolley is arranged to complete an indicator circuit in the engine cab, so that the engineer can ascertain the condition of switches ahead and receive train despatches.

814,314. WINDOW STOP AND BURGLAR ALARM; George H. Parker, New York, N. Y. App. filed Apr. 23, 1904. In order to permit a window to be partly opened and yet secure against the entrance of thieves, the patentee provides a stop which limits the raising movement of the window and which is designed to complete an alarm circuit in case an attempt is made to raise the window.

814,322. REVERSING SWITCH FOR ELECTRICAL CIRCUITS; Thomas S. Perkins, Wilkinsburg, Pa. App. filed June 6, 1904. Motor reversing switch operable by a pilot circuit; has two opposed solenoids acting on an intermediate plunger in the manner of a donkey pump. The plunger has various metallic rings which establish the power circuits through suitable contracting fingers.

814,323. SYSTEM OF REMOTE CONTROL FOR ELECTRIC MOTORS; Thomas S. Perkins and Ray P. Jackson, Wilkinsburg, Pa. App. filed June 6, 1904. A complete multiple control system in which the various controllers are stepped around by ratchet mechanism operable by the pilot circuit. A feature lies in an arrangement by which the controllers must all be stepped around to zero position in case an overload on the motors operates a cut-out on any car.

804,324. CONTROLLER SWITCH; Thomas S. Perkins and Ray P. Jackson, Wilkinsburg, Pa. App. filed June 6, 1904. The controller segments are spaced apart on the usual square shaft and have flat coils axially supported between them, the influence of which is to blow out the arc in whichever direction the segments are moved.

814,325. CONTROLLER OPERATING MEANS; Thomas S. Perkins and Ray P. Jackson, Wilkinsburg, Pa. App. filed June 6, 1904. The controller shaft is spring impelled in one direction and movable by a ratchet to throw on the current. The ratchet acts as an escapement to permit step by step return. A release lever is operable as a cut-out to secure quick return.

814,364. LAMP REGULATOR; Alphonsus L. Drum, Lake Forest, Ill. App. filed Mar. 28, 1905. The various lamps of a train are grouped in a single series multiple circuit receiving current from the trolley. A solenoid automatically cuts out some of the lamps in case the voltage falls below a predetermined value.

814,380. SYSTEM FOR VARIABLE SPEED OPERATION OF ALTERNATING CURRENT MOTORS; Ben. G. Lamme, Pittsburg, Pa. App. filed Oct. 8, 1904. The combination with a source of alternating current electrical energy of approximately constant frequency and a translating device, of means for varying the voltage from said source and separate means for automatically varying the frequency of current alternations supplied by said device in accordance with the voltage variations.

814,386. TELEPHONIC EXCHANGE; William M. Marean, Belvidere, Ill. App. filed June 6, 1904. In a telephone exchange, the combination of a telephone circuit, a main signal circuit leading to the central exchange, a visual indicator device located at central exchange and comprising a plurality of movable indicators, and means under the control of the subscriber for sending impulses over said signal circuit to any one of said indicators, comprising means for subsequently and automatically controlling the telephone circuit.

814,411. TELEPHONIC RELAY; John Trowbridge, Cambridge, Mass. App. filed July 14, 1903. A telephone relay comprising a receiver, its diphragm, a vibrator opposed to the receiver diaphragm and spaced therefrom, a transmitter in connection with the vibrator, and a close metallic connection between the vibrator and the diaphragm.

814,417. DYNAMO ELECTRIC MACHINE; William L. Waters, Milwaukee, Wis. App. filed June 3, 1904. In order to obtain a dynamo electric machine having the characteristics of the ordinary magnet pole type, and also those of the continuous field type as in induction motors, the patentee bridges the pole pieces with small iron rings fastened to their outer edges.

814,461. ELECTRIC DOOR RELEASING DEVICE; Libermond A. Leon, Montreal, Canada. App. filed May 8, 1905. The latch contains a weight or hammer which is raised by the act of closing the door. A magnet controlled detent releases the hammer which falls on the bolt lever and withdraws the bolt.

814,478. TELEPHONE OR TELEGRAPH SYSTEM; George Ritter, Stuttgart, Germany. App. filed June 16, 1904. The combination, with a main line circuit, and a plurality of sub-station instruments connected to said main line circuit, of a controlling device at each sub-station operating directly to render its sub-station instrument operative, an electric circuit including controlling devices, mechanism at each sub-station arranged to regulate the admission of electric current to the circuit connecting said electric devices, and to render its own disconnecting device inoperative, and means at each sub-station arranged to prevent the operation of its own controlling device.

814,482. LIGHTNING ARRESTER· Frank K. Singer, Wheeling, W. Va. App. filed Apr. 17, 1905. Fuse wire is contained in a tube upon the outside of which is wound a choke coil. The fuse tube is supported by fixtures which constitute part of a lightning arrester and the choke coil insures the lightning discharge taking place across the carbon blocks instead of through the fuse wire.

814,498. CAR-HANDLING APPARATUS; Frank E. Woodford, Chicago, Ill. App. Mar. 2, 1905. An apparatus for handling small ore and coal cars. The track is divided into sections, and each section has a pair of trolleys separately energized from a controlling station and which are in circuit with the motors and brake respectively of the particular car which happens to be on that section. Thus an operator for each section is able to perfectly control the movements of each car as it passes his point of the line.

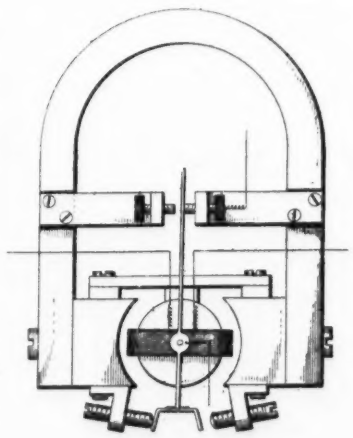
814,501. RELAY; James Allen, U. S. Army. App. filed July 31, 1905. A polarized relay constructed on the lines of an H armature magneto machine, the armature of which lies in the relay circuit.

814,537. SAFETY DEVICE FOR RAILWAY SWITCH AND SIGNAL APPARATUS; Lawrence Griffith, Yonkers, N. Y. App. filed Sept. 20, 1905. The switches are operable by electric means supplied from a power circuit, and the indicators for the switches are not operable until the power current for the switches ceases.

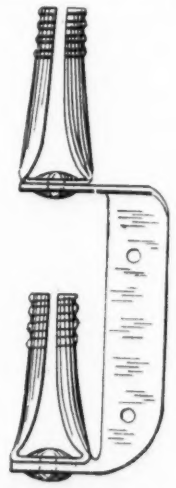
814,535. ELECTRIC SIGNAL APPARATUS; Lawrence Griffith, Yonkers, N. Y. App. filed Oct. 28, 1904. Relates to modifications of the above.

814,571. TELEPHONIC SYSTEM; Elmer A. Terpening, Geneseo, Ill. App. filed Sept. 6, 1904. In a telephone system, the combination of a party line circuit connecting a plurality of subscriber's stations and a central station, means at each subscriber's station for producing direct and alternating current in the lines and a signaling device responsive to alternating current only and at the central station a relay comprising a coil supported for oscillation in a magnetic field, and means for retarding the oscillation of said coil.

814,613. INSULATOR PIN; Frank MacKean, Chicago, Ill. App. filed Feb. 20, 1905. The patentee stamps a piece of sheet metal with two projecting opposed ears which form elements or sections of a



814,501.—Relay.



814,613.—Insulator pin.

resilient pin, having threads stamped thereon to engage the usual threads of the glass insulator.

814,632. SUPPORT FOR OSMIUM FILAMENTS; Carl A. von Welsbach, Vienna, Austria-Hungary. App. filed May 31, 1901. The combination of an osmium filament and a support for the same, said support composed of cintered or fritted refractory oxide, non-adherent to incandescent osmium and chemically indifferent thereto.

814,643. PLURAL SPEED ELECTRICAL CONTROLLER; George N. Eastman, Chicago, Ill. App. filed May 5, 1904. A pair of cut-out magnets are provided, one of which acts slowly on the exciter circuit of the generator and the other of which acts quickly on the main line circuit.

814,658. SAFETY DEVICE FOR RAILWAY SWITCH AND SIGNAL APPARATUS; Lawrence Griffith, Yonkers, N. Y. App. filed Nov. 5, 1904. A signal system by which the signals are operated by compressed air and in which the indicators are not operable until the air pressure is removed.